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MILK RIVER
WATER SUPPLY STUDY

PLAN FORMULATION WORKING DOCUMENT

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GREAT PLAINS REGION
BILLINGS, MONTANA

MILK RIVER IRRIGATION DISTRICTS
MALTA, MONTANA

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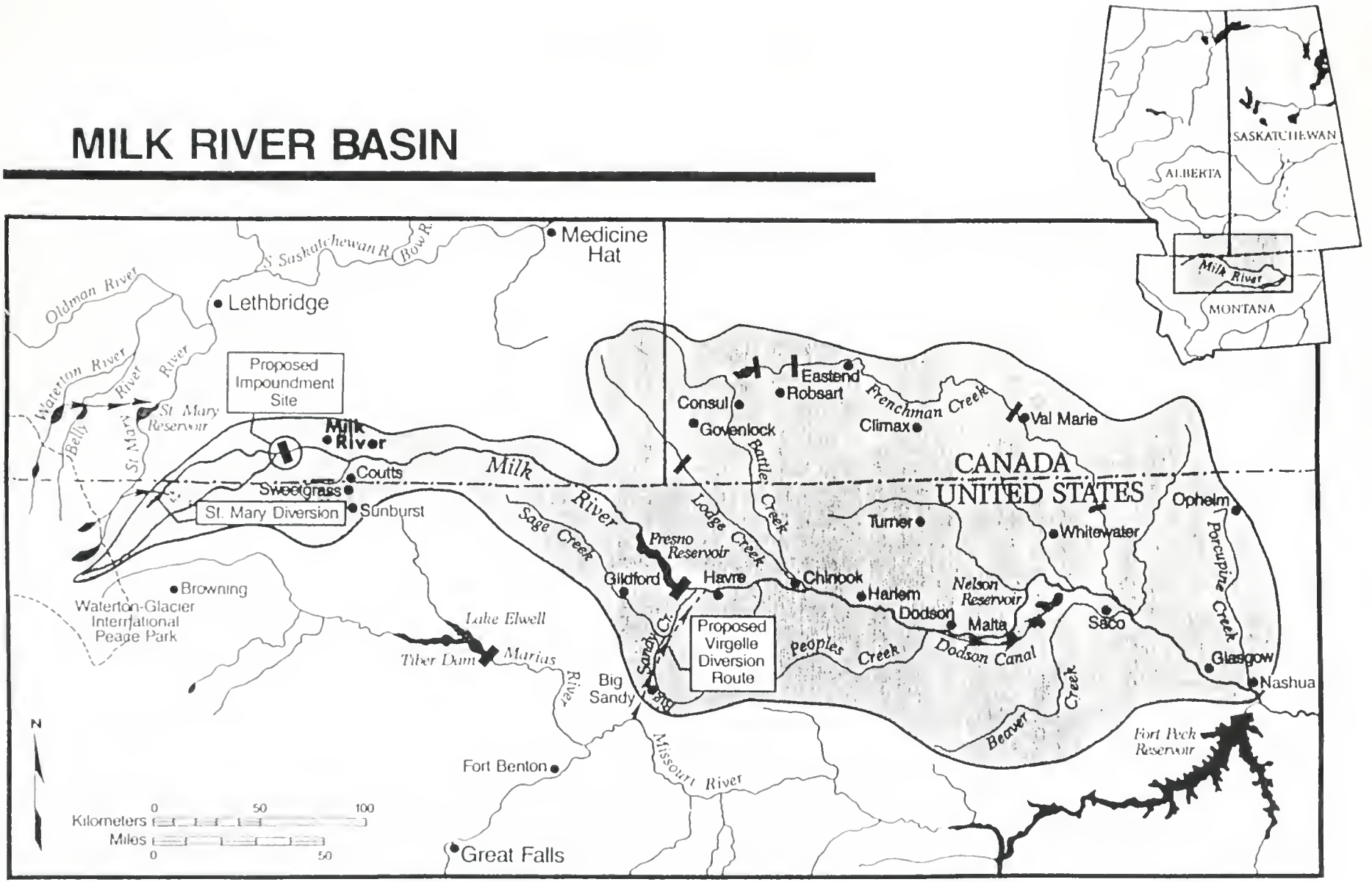
MILK RIVER BASIN



SUMMARY

Background

Irrigation in the Milk River Basin began during the 1880's by small individual systems, then developed into a community system with the construction of a diversion dam at the Fort Belknap Diversion site in 1890. Water shortages soon occurred. In the early 1900's, the Bureau of Reclamation constructed a storage facility (Lake Sherburne) on St. Mary River and a canal from St. Mary River to the North Fork of the Milk River to supplement Milk River flow. Nelson Reservoir, an offstream regulating facility, was added to the system in 1922. After the drought of the 1930's, Fresno Reservoir was constructed to provide more storage and to provide better management of the water diverted from St. Mary River.

There are now over 138,000 irrigated acres in the Milk River Basin. These include 92,000 acres within the Milk River Project, 11,000 acres which are irrigated under individual contracts with the Bureau, 10,425 acres on Fort Belknap Reservation, and 25,000 acres of land being irrigated under a water right junior to all others.

Problems Today and Tomorrow

Today, Milk River irrigators face significant water shortages in 6 years out of 10. Recent examples of shortages occurred in 1983 and 1985 when the basin experienced diversion shortages of more than 35 percent. In 1984 the water supply was less than one-half of the annual diversion requirement. The average annual shortage is 122,600 acre-feet or 20 percent of diversion requirement. These shortages are caused by a combination of periodic severe droughts, overdevelopment of irrigation relative to the water supply, and aging canals that are unable to carry enough water demands of current irrigation operations.

Unfortunately, today's shortages will increase about 28,000 acre-feet in the future when Canada and tribes on the Fort Belknap Reservation make use of their legal share of Milk River waters. About 200 miles of the Milk River cross the province of Alberta, Canada.

Over the years, Alberta has not used its full share of Milk River water, allowing it to be used by Montanans downstream. Now Alberta proposes to build a dam to provide water for irrigation in Canada. When Alberta uses its full share of water, average annual water shortages of Montana irrigators would increase by about 15,000 acre-feet.

The Gros Ventre-Assiniboine Tribes on Fort Belknap Reservation are negotiating their reserved water right. If the Tribes were granted a right to all the natural flow of the mainstem and tributaries of the Milk River upstream or rising on the reservation, the average shortage of other basin irrigators would be increased about 13,000 acre-feet. It was assumed for this study that a total of 24,000 acres would be irrigated on the reservation. This assumption was based on the number of acres which could be served by the existing Fort Belknap Diversion Dam. Study results show that in addition to their senior reserved water right, the Tribes on Fort Belknap Reservation will require a supplemental water supply to provide a full supply to 24,000 acres.

Water rights on the Milk River are presently being adjudicated by the State of Montana. Upon completion of the adjudication, distribution of water shortages in the basin should change. In the past, some landowners with junior water rights have diverted Milk River water during periods when the water supply was only adequate for landowners with junior water rights. When water rights are adjudicated and enforced, these individuals with junior water rights will be forced to cease or reduce diverion when water supplies are limited. Therefore, they will bear a much larger share of the shortages than they have in the past.

In addition to the irrigation water needs, about 7,500 acre-feet of exchange water is needed to allow the Bureau of Land Management to develop stockwater ponds on the tributaries of the Milk River. About 16,000 acre-feet of water is needed to restore waterfowl production at the Bowdoin National Wildlife Refuge and additional municipal water is needed for the town of Chinook.

Solutions to the Problem

The Milk River irrigators have been working with Reclamation and Montana Department of Natural Resources and Conservation (DNRC) to find a solution to the persistent shortages. A three-phased plan has been formulated to provide this solution. This plan involves basin-wide management of the water supply available; rehabilitation of the aging canals, laterals, and onfarm systems; and a new source of water.

Phase 1

Phase 1 is ongoing. A joint board of control is being established by the Milk River irrigators. This board will coordinate and consolidate basin-wide irrigation operation for more efficient and effective use of water equipment, and district staff.

The irrigation districts are also restoring the St. Mary Canal to its original design capacity of 850 ft^3/s; present capacity is estimated at 700 ft3/s. The diversion from St. Mary River via the St. Mary Canal provides a substantial amount of the water supply available to the Milk River irrigators. Restoring the canal would reduce the average annual shortages by an estimated 16,000 acre-feet (see Figure S-1).

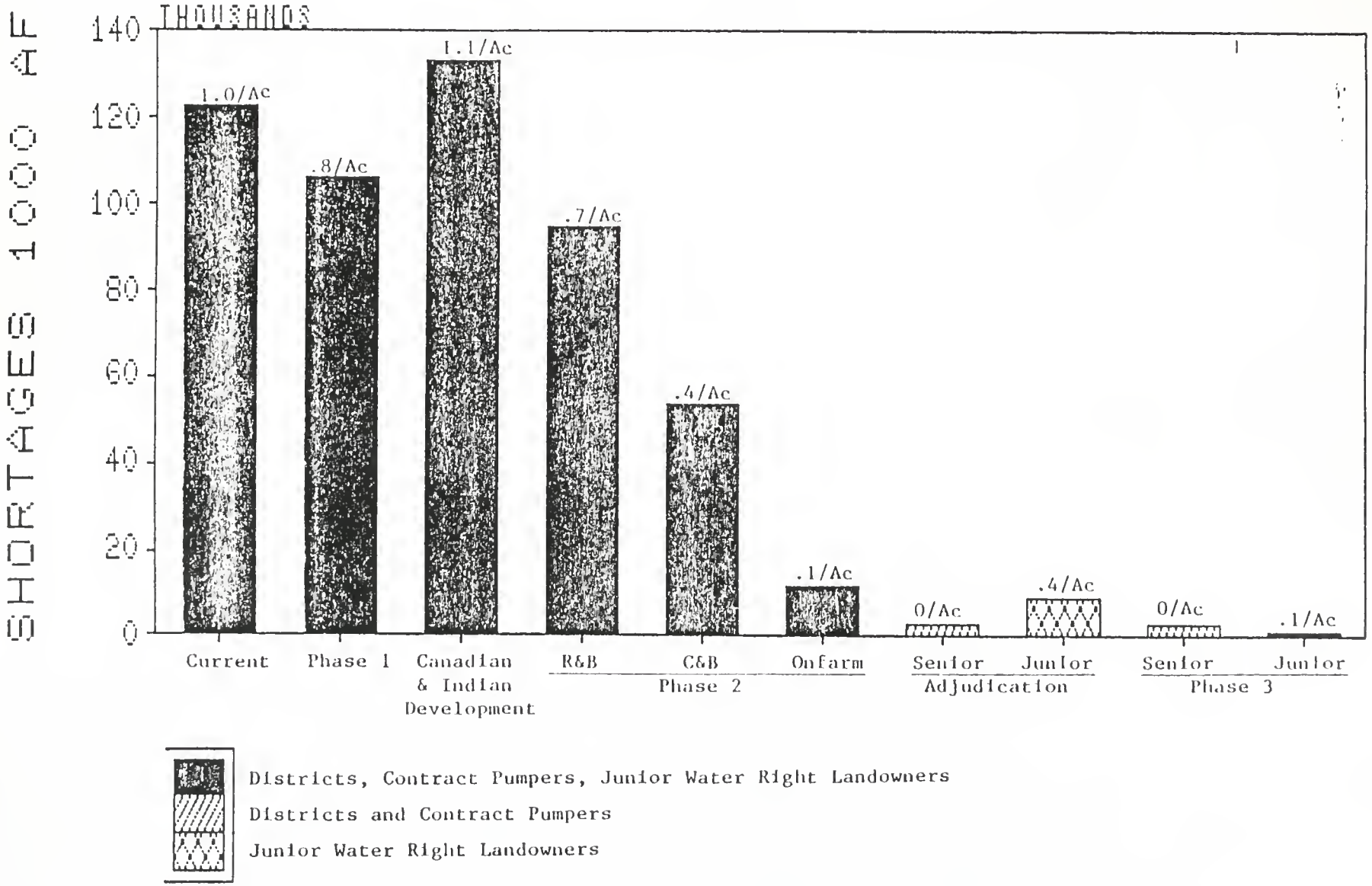
Phase 2

Phase 2 will focus on reducing the demands at canal headgates by improving conveyance efficiencies, through rehabilitation of the canals and laterals, and increasing onfarm irrigation efficiency. Canals would then have adequate capacity to carry the water needed to meet crop irrigation demands. In addition to conserving water, Phase 2 will: (1) restore the reliability of the system, (2) provide measuring devices for the equitable and efficient distribution of water, (3) provide safety features for protection of human life, (4) restore design capacity to the system, thus reducing the risk of system failure, (5) permit reclamation of agricultural lands affected by canal seepage, (6) improve annual operation and maintenance, and (7) ensure the continued social and economic welfare of the area. Without rehabilitation, water shortages will continue, and some of the larger facilities in the system will inevitably fail.

FIGURE

WATER SUPPLY AND FACILITY SHORTAGES

AVERAGE



Phase 2 includes three elements--Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement. The Rehabilitation and Betterment element concentrates on project features requiring immediate action. This includes lining laterals with slip-form concrete or placing them in pipe; lining sections of main canals with compacted earth or membrane lining; repairing or replacing canal structures; realigning, deepening and rehabilitating open drains, building new drains, and installing measuring devices.

The Construction and Rehabilitation element will rehabilitate a major portion of the entire system. Obsolete structures will be replaced with modern partially automated ones to save labor, canals will be reshaped and lined to conserve water and improve delivery efficiency, gravel service roads along the waterway will provide better access for operation and maintenance, and drain works will be improved. Dodson Diversion Dam will be replaced and the Fort Belknap Diversion Dam modified. Automated slide gates will be installed on the headworks of several of the canals, and measuring devices will be installed on all farm turnouts and laterals.

The Onfarm Efficiency Improvement element requires two parts: the implementation of a basin-wide irrigation management system and a program of onfarm improvements and operational changes designed to increase the irrigation efficiency by 15 percent over the present level. Onfarm improvements include field leveling, border dikes, gated pipes, concrete-lined head ditches, sprinklers, and automated controls on head ditches. The total cost of Phase 2 is $101,200,000 (see Summary Table for details).

Phase 2 will have a favorable effect on the aquatic resources of the area; the flows in the river will be higher during dry periods and reservoirs will be held at higher levels. The most critical effect on terrestrial species will be elimination of habitat in seeped areas along canals and laterals. To mitigate, areas will be managed for wildlife along Beaver Creek (2,755 acres), Nelson Reservoir (1,340), Dodson Canal (558), Vandalia Diversion Dam (400 acres) and Lonesome Lake (5,600 acres).

Phase 2 was tailored to benefit the Milk River irrigation districts and contract pumpers. These irrigators would be the primary beneficiaries.

Phase 3

The irrigation districts and contract pumpers would have a full water supply after implementation of Phase 2 and enforcement of adjudicated water rights. Phase 3 was formulated to provide an adequate water supply to the landowners with junior water rights, Gros Ventre-Assiniboine Tribes on Fort Belknap Reservation, Bureau of Land Management stockwater ponds, Bowdoin National Wildlife Refuge, and the town of Chinook.

The Preferred Plan for Phase 3 is the Virgelle-Milk 230 ft^3/s Canal Alternative. The main features include a pumping plant, canal, and distribution and drainage systems for canalside lands.

The pumping plant would be located upstream of Boggs Island on the Missouri River. An infiltration gallery design is being proposed to avoid impacts on the fishery, reduce transport of weed seeds, and minimize visual intrusions in this Wild and Scenic River corridor. A plot would be excavated from the bottom of the river bed and filled with gravel. Well screens would be laid horizontally in the gravel bed. Water would be drawn through this gravel filter and pumped into a discharge line to the canal.

Electric transmission facilities would probably be provided by a 69 kilovolt line from a substation at the town of Big Sandy to the pumping plant.

The canal would follow the Burlington Northern Railroad line right-of-way most of the way from the Missouri River to the Milk River. The canal would be about 12 feet wide at the bottom, 40 feet wide at the top, and $7\frac{1}{2}$-feet deep. A total of 35 canal crossings would be built along the 46-mile canal route to provide access to adjacent landowners.

The canal provides an opportunity to provide water to lands in the Big Sandy area, which are presently dryland farmed. This includes about 3,300 acres of Rocky Boy's Reservation and 3,245 acres irrigated by private landowners. Costs are included for distribution and drainage system for these lands.

The total cost for Phase 3 is $87,000,000 (see Summary Table for details). The benefits exceed costs by a ratio of 1.24:1.0. The major environmental and social concerns addressed during plan formulation are effects on wildlife habitat, effects on fishery in the Missouri and Milk Rivers, seepage along Virgelle-Milk Canal, spread of weeds in canal area and severance of farmlands along the canal route. The effect on the environmental would be insignificant. The summary tables present the environmental and social effects in detail; the major environmental concerns are addressed below.

About 16,000 acre-feet of water would be provided to Bowdoin National Wildlife Refuge. Wetland habitat in the refuge has been destroyed by an accumulation of salts due to an inadequate water supply. This firm water supply will restore waterfowl production to normal levels and freshen degraded wetlands.

About 300 acres of native rangeland would be affected by construction of the Virgelle-Milk Canal. These impacts would be mitigated by reseeding the right-of-way. Irrigation of canalside lands would cause the loss of about 1,300 acres of native range. A tentative mitigation recommendation is to manage part of Lonesome Lake for wildlife. The Federal Government owns about 14,000 acres around the lake, so no land need be acquired.

The infiltration gallery design would minimize the potential for impacting Missouri River fisheries. When flows in the Missouri are below the instream flow requirements, releases would be made from Tiber Reservoir into the Marias River (a Missouri River tributary) to replace project diversions. The flows in the Milk River will not change significantly. Therefore, the fishery will not be adversely affected.

One of the primary concerns of the Big Sandy Area residents along the canal route is that a canal through the area would increase seeps occurring in this dryland area. The canal would be lined with membrane lining to ensure that seeped areas would not increase.

Another concern of the Big Sandy area residents is the transport of weeds. The infiltration gallery design pumping plant would avoid weed transport. The Bureau also recommends that a weed control board be established with representation from the Milk River Irrigation Districts and Big Sandy area to ensure that the canal right-of-way is maintained adequately.

The route selected for the canal lessens the impact on adjacent landowners by following the railroad right-of-way, which has been abandoned along half the route. Crossings have been included in canal design to provide access.

A Class III cultural resource survey of the canal route revealed that 14 prehistoric and historic sites are in the right-of-way. Three of these sites are considered eligible or potentially eligible for the National Register of Historic Places. Of primary concern is the Great Northern Railroad and some associated features which have been determined eligible as a National Historic District. Other potentially eligible sites include prehistoric stone circles with rock cairns and artifact scatters. Site evaluations and determinations of effect will be made for each of the eligible or potentially eligible sites.

Potential Canadian Reservoir

As discussed earlier, Canada may build a reservoir in Alberta on the Milk River. Milk River irrigators may be able to lease storage in this reservoir. The irrigators and DNRC are discussing a potential leasing arrangement with Alberta Environment. If this reservoir became a reality, leasing storage could be an alternative for the Virgelle-Milk Canal. The planning of the reservoir is a matter for the Province of Alberta. The studies for Phase 3 focused only on plan selection for the canal. Appropriate planning and NEPA compliance documents were prepared for Phase 1 and 2 by the responsible entities. NEPA compliance for Phase 3 will be via the Planning Report/Draft Environmental Statement (PR/DES) that will be prepared when the PFWD is finalized.

Summary Table

Feature	Phase 2 Conservation & Rehabilitation (Future Without Condition)	Phase 3 230 ft^3/s Canal (Preferred Plan)
Rehabilitation Program	Line canals and laterals or place in pipe	---
	Repair or replace canal structures	---
	Rehabilitate drains and construct new drains	---
	Install measuring devices	---
	Replace Dodson Diversion Dam	---
	Modify Fort Belknap Diversion Dam	---
	Improve Onfarm Systems and Operation	---
Pumping Plant - Infiltration gallery design		
Capacity		230 ft^3/s
Total dynamic head		220 feet
Infiltration Gallery BED		660' x 310'
Discharge line		
Length		3,000 feet
Diameter		66 inches
Intake Approach Velocity		.02 ft/s
Canal		
Capacity		230 ft^3/s
Length		46 miles
Canal Crossings		35
Dimensions		
Width at Bottom		12 feet
Width at Top		42 feet
Depth		7½ feet
Canalside Feature		Distribution and Drainage System
Drainage System for Junior Water Right Acres along Milk River	-----	650 miles
Drainage System for Contract Pumpers	540 miles	---
Mitigation	Manage areas along Beaver Creek, Nelson Reservoir, Dodson Canal and Lonesome Lake	Convert cropland to rangeland on ROW and manage areas around Lonesome Lake

Implementation of Plan

The Milk River irrigation districts are implementing Phase 1 of the plan. Restoration of St. Mary Canal will be complete by 1990.

Phase 2 is being completed under Reclamation's Rehabilitation and Betterment Program. Reclamation is completing Rehabilitation and Betterment studies for the Malta and Glasgow Divisions. The DNRC is completing similar studies for the Chinook Division on Dodson Pumping Unit. These reports include the Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement elements. The Rehabilitation and Betterment element for Malta and Glasgow Divisions could be funded as part of the R&B Program. This Rehabilitation and Betterment element for Chinook and Dodson Pump Unit could be funded under Reclamation's Small Projects Loan Program or from a State of Montana program.

Implementation of the Rehabilitation and Betterment element would provide a partial solution to the water shortages in the basin. The Milk River irrigators, Reclamation, and the State are seeking a complete solution. It is proposed that the three-phased plan be authorized as part of the Pick-Sloan Missouri Basin Program. Phase 1 (creation of Joint Board of Control and restoration of St. Mary Canal) should be completed and funded by the project sponsors. Phase 2 would be completed under the Rehabilitation and Betterment Program and integrated into the Pick-Sloan Missouri Basin Program. Phase 3 would be planned and constructed by Reclamation and integrated into the Pick-Sloan Missouri Basin Program.

	Phase 2 Conservation & Rehabilitation (Future Without Condition)	Phase 3 230 ft^3/s Canal (Preferred Plan)
Benefiting Acres		
Districts and Contract Pumpers	103,000 acres	103,000 acres
Junior Water Right Acres	---	25,000 acres
Fort Belknap Indian Reservation	---	24,425 acres
Bureau of Land Management	---	7,500 acre-feet
Municipalities	---	200 acre-feet
Rocky Boy Reservation	---	3,300 acres
Private Canalside Irrigation	---	3,243 acres
Bowdoin National Wildlife Refuge		15,700 acres
Construction Costs (January 1987 price levels)		
Rehabilitation and Betterment	14,200,000	---
Construction and Rehabilitation	68,400,000	---
Onfarm Efficiency Improvement	18,600,000	---
Pumping Plant and Canal	---	44,000,000
Rocky Boy's Reservation Distribution		5,000,000
Rocky Boy's Drainage	---	3,000,000
Canalside Distribution	---	4,000,000
Canalside Drainage	---	4,000,000
Drainage for Lands Irrigated with Junior Water Rights		28,000,000
TOTAL	$101,200,000	$88,000,000
Annual Economic Costs		
Construction	NA	4,443,000
Drainage	NA	844,000
Interest During Construction (8-5/8%)	NA	391,000
Opportunity Cost of Energy	NA	356,000
OM&R (including energy)	NA	313,000
TOTAL ANNUAL ECONOMIC COST		6,347,000
Annual Benefits		
Irrigation	NA	6,084,000
U.S. Fish and Wildlife (Lake Bowdoin)	NA	122,000
BLM Stockponds	NA	71,000
Drainage	NA	675,000
Unemployment	NA	156,000
Regional Benefits	NA	781,000
TOTAL Annual Benefit		7,889,000
Net Annual Benefit		1,542,000
B/C Ratio		1.24

Repayment	Payment Over 30 Years	Payment Over 40 Years
U.S. Fish & Wildlife Service	---	Nonreimbursable
BLM	---	Nonreimbursable
Junior Water Right Landowners	---	$11.41/acre
Fort Belknap Reservation	---	Deferred
Canalside		
Private	---	$81.58
Rocky Boys	---	Deferred
Districts	$5/acre	----

Environmental Factor:	Present Condition	Phase 2 (Future W/O Project) 1/	Phase 3 230 ft^3/s Canal (Preferred Plan)	Significance 2/
Fisheries:				
Milk River	Classified as B-3. Fisheries resources are reduced during dry years because of low runoff, low releases from reservoir, and increased withdrawls for irrigation.	Biological assessment for the individual R&B and C&R projects concluded no effect. An analysis regarding the cumulative effects of these actions is currently underway.	Flows in river will be at higher level during dry years which should enhance fishery. Possible import of species from Missouri River.	+
Missouri River	Classified as B-3.	No change.	Infiltration gallery design will minimize potential for impacting fisheries. Construction of gallery and pumping plant may disturb potential spawning areas during construction period.	0
Marias River	Classifications are B-2 and B-3 below Tiber Dam (see Water Quality).	No change.	Releases from Tiber Dam would benefit fishery in Lower Marias.	+
Tiber Dam/ Lake Elwell	High quality fishery for walleye and northern pike.	No change expected unless upstream development were to occur.	Sufficient water is available, at least in average years, to maintain existing seasonal reservoir level operating goals.	0
Fresno Reservoir	Moderate fishery for walleye and northern pike. Presently, it is believed that carp are not present in the reservoir or in the Milk River upstream.	No change expected unless upstream development were to occur.	Project operations would not differ significantly from existing operations.	0
Nelson Reservoir	Excellent walleye fishery.	No change expected unless upstream development were to occur.	No adverse impacts anticipated. Maintain walleye fishery.	0
Wildlife Habitat:	Habitat had developed along the existing canal system and on some adjacent lands due to seepage.	Rehabilitation of existing facilities and construction of new, efficient ones will remove habitat that has developed. However, R&B and C&R projects incorporate mitigation areas to compensate for the losses.	Habitat losses that occur as a result of building the canal and irrigating canalside lands will be mitigated for within the canal ROW and by managing an area of Lonesome Lake.	0

Environmental Factor:	Present Condition	Phase 2 (Future W/O Project) 1/	Phase 3 230 ft^3/s Canal (Preferred Plan)	Significance 2/
Water Quantity				
Missouri River	Annual flow is 6,333,000 acre-feet.	Flows would continue as occur presently.	Project would withdraw up to 230 ft^3/s during April through September, the effects of which would be unmeasurable most years.	0
Milk River	Average annual flow in Milk River is 267,150 acre-feet.	Inflow to Milk River will decrease 40,000 acre-feet if Canadian projects are developed. Restoration of St. Mary's Canal will increase flows an average of 16,000 acre-feet.	Supplemental (replacement) water from Missouri River, in conjunction with future w/o conditions will assure full water supply to irrigators and maintain or enhance fish and wildlife resources.	+
Marias River and Lake Elwell	Lake Elwell is operated primarily for flood control. Consequently, reservoir elevations, and river flows below Tiber Dam, fluctuate considerably.	Present conditions would continue.	Releases from Lake Elwell to replace instream flows in the Missouri River would increase reservoir fluctuations but should improve flows in the Lower Marias downstream of the dam in dry years.	+++
Bowdoin National Wildlife Refuge	Inadequate water supply to maintain adequate water levels and freshen ponds.	Excess water could be available more often for Lake Bowdoin (estimate 2,700 acre-feet annual).	Additional water in the Milk River could be used to benefit productivity of Bowdoin National Wildlife Refuge and freshen refuge.	+++
Threatened/Endangered Species:	Species that could occur in the area are: peregrine falcon, bald eagle, black-footed ferret and piping plover.	Biological assessments for the individual R&B and C&R projects have concluded no effect. An analysis regarding the cumulative effect of these actions showed no effect.	No effect.	0
Cultural Resources:	There are known sites but the specifics are lacking.	Cultural resources survey and mitigation requirements have been accomodated for the individual R&B and C&R projects.	Class III survey of canal route and adjacent lands completed.	0
Weeds:	Spotted knapweed and leafy spurge presently not known to occur on lands between Milk and Missouri Rivers.	These weeds will eventually invade these lands.	Use of an infiltration gallery for pumping plant intake should prevent transport of seeds from Missouri River. Reclamation recommends a weed control board to assure that canal ROW is properly managed.	0

1/ The Future W/O Project Condition (Phase 2) assumes that the proposed R&B and C&B projects in and along the Milk River will be in place along with improvements in onfarm irrigation efficiency, prior to building the canal. The cumulative effects of this scenario regarding threatened/endangered species, and fish and wildlife resources, is presently being evaluated.

2/ - Minor adverse
-- Moderate adverse
--- Highly adverse
0 No significant effect
+++ Highly beneficial
++ Moderately beneficial
+ Slightly beneficial

Environmental Factor:	Present Condition	Phase 2 (Future W/O Project) 1/	Phase 3 230 ft^3/s Canal (Preferred Plan)	Significance 2/
Water Quality:				
Marias River	Classified as B-2 water source from Tiber Dam to Highway 223 i.e., suitable for drinking, cooking, and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated quatic life, waterfowl, and fur bearers; and agricultural and industrial water supply. B-3 from Hwy. 223 to Missouri River.	No change.	Releases from Lake Elwell should improve water quality during dry years.	0
Milk River	Classified as B-3 which is similar to B-2 except waters are of a lower quality and are not suitable for the growth and propagation of salmonid fishes and associated aquatic life.	No change.	Possible changes in temperature due to import of waters being studied. Increased flow in river during dry years should improve water quality.	0
Missouri River	Same as Milk River.	No change.	No change.	0
Bowdoin National Wildlife Refuge	High salt concentrations.	No change.	16,000 a.f. will freshen refuge.	+
Groundwater (Seepage):				
Milk River Basin	Existing irrigation facilities have seepage problems which, in turn, have caused the loss of agricultural productivity on the affected lands.	Rehabilitation of existing facilities and designs eliminating/ reducing seepage from new facilities will return productivity to affected lands.	No change.	0

COMPARISON OF SOCIAL ACCOUNTS

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal 230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Farms Crossed (By Canal)	The Big Sandy area is presently dryland farmed.	No change in Big Sandy area.	19 farms crossed by canal - 35 bridges provided, averaging about 1-mile intervals.	Same as Preferred Plan.	Same as Preferred Plan.
Weed Spread	Spotted knapweed and leafy spurge not known to occur along canal route.	No change in Big Sandy area.	Potential for weed spread, controlled by infiltration design pump, and weed control programs.	Essentially same as Preferred Plan.	Essentially same as Preferred Plan.
Seepage from Canal	Saline seeps occur in Big Sandy area.	No change in Big Sandy area.	Seepage from canal controlled by canal lining and toe drains.	Essentially same as Preferred Plan.	Essentially same as Preferred Plan.
Population	Rural area. Historical trend of rural population decline.	Overall population increase of about 10 percent by year 2000. Historical trend of rural population decline will continue. 1/ Increase of 100 people during 10-year construction period. Slight decrease in rate of long-term rural population loss.	Construction period population increase of 290 people, mostly in Hill and Choteau Counties. Slight decrease in rate of long-term rural population loss.	Same as Preferred Plan, except increase of 260 people during construction.	Same as Preferred Plan, except increase of 230 people during construction.
Employment	Historical trends of increases in urban and decline in rural areas. High unemployment on Rocky Boy's and Fort Belknap Reservations.	Continuation of historical trends. Unemployment on reservations will remain high. Annual direct onsite employment of 50 jobs during 10-year construction period.	Direct onsite employment during construction of 180 jobs, 70 available to Rocky Boy's and Fort Belknap Reservations. Increase of 45 agricultural jobs.	Onsite employment of 160 jobs, 60 available to reservations. Increase of 40 agricultural jobs.	Onsite employment of 140 jobs, 50 available to reservations. Increase of 40 agricultural jobs.

1/ Source: 1980 OBERS Regional Projections, U.S. Department of Commerce.

COMPARISON OF SOCIAL ACCOUNTS
(Continued)

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal 230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Income (During Construction and Annual Agricultural Income)	Area is dependent upon agricultural base which is stabilized by irrigation. Per capita income below national average. Annual average water shortages of over 20 percent will continue to have an adverse impact on income.	Per capita income will remain below national average. Current dollar income will increase by 60 percent by year 2000, but ag sector by only 35 percent. 1/ Earnings during construction would be about $2.7 million. Indirect regional earnings of about $2 million. Average increased annual direct and indirect agricultural income of $8.5 million.	Direct earnings during construction would be about $6.8 million, about $2.7 million of which would accrue to Tribes. Average annual increased direct and indirect agricultural income of $8.2 million, $2.2 million of which would accrue to Tribes.	Similar to Preferred Plan, except construction earnings of $5.9 million, with about $2.3 million accruing to Tribe. Average annual increased direct and indirect agricultural income of $7.6 million; with about $2.2 million accruing to Tribes.	Similar to Preferred Plan, except construction earnings of $4.8 million, with about $1.9 million accruing to the Tribe. Average annual increased direct and indirect agricultural income of $6.9 million, with about $2.2 million accruing to Tribes.
Housing	As of 1980, housing vacancy rate of 15 percent within five counties comprising Milk River Water Supply Study service lands and canal area. Current and future rates should be comparable due to depressed rural economics.	About 20 additional housing units required during construction. Could be accommodated in project area without undue stress.	About 60 additional housing units required during construction.	Same as Preferred Plan, except 55 units required.	Same as Preferred Plan, except 50 units required.
Facilities and Services	Area typical of rural areas in the State, in which provision of social and medical services difficult due to distances traveled.	Increased pressure on medical and dental facilities during construction. Sufficient school facilities to accommodate 30 additional students.	Increased pressure on medical and dental facilities during construction. Sufficient school facilities to accommodate 100 additional students.	Similar to Preferred Plan, except 90 additional students would be accommodated.	Similar to Preferred Plan, except 80 additional students wold be accommodated.

COMPARISON OF SOCIAL ACCOUNTS
(Continued)

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal		
			230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Annual Cost (Annual Equivalent Economic Cost)	N/A	Annual costs of $8.7 million.	Annual costs of $6.4 million.	Annual costs of $5.5 million.	Annual costs of $4.5 million.
Indian Lands (Acres irrigated)	N/A	N/A	13,150 acres of land irrigated on Fort Belknap and Rocky Boy's Reservations.	Same as Preferred Plan.	9,750 acres of land irrigated on Fort Belknap Reservation.

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CHAPTER 1: INTRODUCTION

PURPOSE AND SCOPE

The water users in the Milk River Basin experiences severe water shortages. The purpose of this study is to determine the best way to alleviate these shortages. The preferred plan is a combination of water conservation, improved water management, and an increased water supply.

LOCATION AND SETTING

The Milk River rises east of the Continental Divide at the confluence of three streams on the Blackfeet Reservation, flows 216 miles through the Province of Alberta, and then reenters the United States in Hill County, after which it flows another 490 river miles to its confluence with the Missouri River (see frontispiece). The Milk River drains an area of 23,300 square miles, of which 15,521 square miles are in the United States.

The climate of the basin is semiarid with hot summers and cold winters. The frost-free season varies, averaging about 126 days per year. Annual precipitation ranges from 12.5-14 inches. Approximately 50 percent of the precipitation occurs April-September.

Agriculture is the basis of the economy in the Milk River Basin. Over 138,000 acres are presently irrigated from the mainstem of the Milk River. Most of these acres are served by the Milk River Project, one of the earliest Federal irrigation projects. Facilities of the project include Lake Sherburne on the St. Mary River, St. Mary Canal which diverts water from St. Mary River to Milk River, Fresno Reservoir on the Milk River, and Nelson Reservoir, an offstream storage facility. The Milk River Project includes three divisions. The irrigation districts within each division and the diversion facilities and canals are as follows:

Division/District	Diversion Facility	Canals
Chinook Division		
Fort Belknap District	Fort Belknap Diversion Dam	Fort Belknap
Alfalfa Valley District	Fort Belknap Diversion Dam	Fort Belknap
Zurich District	Fort Belknap Diversion Dam	Fort Belknap
Paradise Valley District	Paradise Valley Diver. Dam	Paradise Valley
Harlem District	Pump	Harlem Canal
Malta Division		
Malta District	Dodson Diversion Dam	Dodson North Dodson South Nelson South
Dodson District	Dodson Diversion Dam	Dodson North
Glasgow Division		
Glasgow District	Vandalia Diversion Dam	Vandalia

Most irrigated lands are on the level floodplain and terraces in the valley, but some are located on rolling glacial uplands and on gently sloping alluvial fans deposited by tributary streams. Soils are typically medium-textured near the river, and finer-textured away from the river. Much of the floodplain is underlain by stratified alluvial deposits, while the gravelly well-developed soils of the glacial uplands are usually underlain by glacial till.

Several large seeps evidence drainage problems on the Milk River Project. Drainage is made more difficult by natural levees which are often higher than the farmland further from the river. The levees impede natural surface drainage, causing ponding and consequently complicating subsurface drainage.

Although irrigated agriculture is the predominant land use in the valley, riparian and other wildlife habitat is common in the area. The river's oxbows, sloughs and extensive canal systems support substantial riparian areas, with interspersed croplands providing excellent diversity. Seepage from many of the canals has allowed the creation of wetlands not present under natural conditions. Vegetation along the waterways is primarily a grass-forb moisture with occasional concentrations of rose, willow, buffalo-berry and scattered cottonwood. Upland areas away from the river are largely rangeland and dryland cropland.

The Milk River Valley supports large numbers of waterfowl, game and nongame birds, mammals, reptiles and amphibians. Three wildlife species listed as endangered by the Federal Government could occur in the area: peregrine falcon, black-footed ferret and bald eagle. The piping plover is listed as threatened.

BLACKFEET RESERVATION WATER DEVELOPMENT POTENTIAL

The Blackfeet Reservation, located in Glacier and Pondera Counties, Montana, borders both Glacier National Park and Canada. To the extent that the headwaters of the Milk River lie within its boundaries, the reservation is associated with the Milk River Irrigation Project. Also, key project facilities used in the storage and transfer of St. Mary River water to the Milk Basin (St. Mary Canal and Sherburne Reservoir) are located on the reservation.

Recently the Blackfeet identified potential water development proposals that need to be integrated into the Milk River Water Supply Study. These specific development proposals are currently in a conceptual stage and are presented as such in this document. The proposals are not expected to have a significant effect on the proposed program to resolve irrigation water shortages in the Milk River Basin. The Tribe will participate with the Department of Natural Resources and Conservation, the Milk River Irrigation District, and the Bureau of Reclamation in evaluation of the development proposals on the reservation as approved by the Tribal Council. Results on this evaluation would be presented in the Regional Director's Planning Report/Draft Environmental Statement.

A brief description of several water development options on the Blackfeet Reservation are presented below. The list is meant to be illustrative of the forms of development that will be considered and is not intended to be all inclusive.

1. Storage in Lower St. Mary Lake -- The surface elevation of Lower St. Mary Lake, a natural body of water located on the reservation, could be

raised 2 to 5 feet and thereby store an estimated 5,000 to 15,000 acre-feet of water. Since this water would come out of the U.S. share of St. Mary River flows, the project would necessitate a revision of the computational procedure for apportioning flows between the United States and Canada.

2. Instream flow in Swiftcurrent Creek -- Releases from Sherburne Dam on Swiftcurrent Creek flow into Lower St. Mary Lake and then to the St. Mary River where the diversion dam for the St. Mary Canal is located. During the irrigation season, the reservoir releases generally maintain an acceptable instream flow in Swiftcurrent Creek. Providing adequate instream flows in the off-season would require yearly storage releases of about 20,000 acre-feet. Since these stored flows would otherwise be diverted for use on the Milk River Irrigation Project, alternative developments would be needed to offset these losses.

3. Enlargement of Spider Coulee Lake -- Located on the St. Mary Canal, water diverted from the St. Mary Basin flows through Spider Coulee Lake. The dam creating this lake would be raised and, with a change in operation of the St. Mary Canal during April and May, the lake's storage capacity would increase in excess of 5,000 acre-feet.

4. Divert Kennedy Creek flows directly into the St. Mary Canal -- Kennedy Creek is the last major tributary to the St. Mary River between the diversion dam for the St. Mary Canal and the Canadian border. Currently, Kennedy Creek waters flow unused into Canada since a siphon for the St. Mary Canal is located under Kennedy Creek. Nonetheless, the creek has high flows in the spring that could be diverted into the canal and stored in an enlarged Spider Coulee Lake. An option would be to store spring flows in a reservoir on Kennedy Creek for later diversion during the irrigation season.

5. Irrigation Development in the Cutbank Creek Drainage -- Currently a contractor to the Bureau of Indian Affairs is conducting a soils classification study to delineate irrigable soils throughout the reservation. Lands in the Cutbank Creek drainage are among those being classified and several areas appear favorable for irrigation development. A water supply

needed to sustain such use would require a diversion from the St. Mary River into the St. Mary Canal and subsequently to a lateral that leads to the Cutbank Creek drainage. The development of reservoir storage in Cutbank Creek would be an important aspect of this option. Crops to be irrigated, which largely include alfalfa, pasture, and field grains, would be used to support an expanded livestock economy.

6. Power Development on Drops in the Milk River Canal -- In 1985, a reconnaissance-level examination was made on the potential for small hydropower development on five drop structures along the St. Mary Canal route. An assumption used in this examination centered on the diversion of flows in the existing canal into a new canal with a capacity of 490 cubic feet per second. Located above the first drop structure, this new canal would divert flows for 2.8 miles to a 600-foot penstock with an elevation drop of 180 feet. Once used in the powerplant, the flows would return to the North Fork of the Milk River about one-half mile upstream of the point where the canal presently enters the river. Also, if the St. Mary Canal was modified to deliver water to the Cutbank Creek drainage, consideration would be given to installing a penstock for a future powerplant.

PREVIOUS STUDIES AND AUTHORITY

Water shortages in the Milk River Basin have been the subject of many studies. Since the early 1970's the Bureau of Reclamation (Reclamation) and the State of Montana have investigated plans for delivering additional water to the basin (Reclamation 1977, DNRC 1977). Although some of the early plans were shown to be economically feasible, no action was taken at that time.

At the request of the Milk River Irrigation District in 1984, the Montana Department of Natural Resources (DNRC) and Reclamation focused on plans to divert water from the Marias River to the Milk River. Although the Marias-Milk diversion was found to be economically infeasible, seven other alternatives were developed. These seven alternatives were evaluated as part of the present study.

In addition to this report, Reclamation is also making engineering and financial surveys for the complete rehabilitation of the Glasgow and Malta Irrigation Districts for inclusion in Reclamation's Rehabilitation and Betterment Program. The DNRC is completing a similar study for the Chinook Division and Dodson Pumping Unit. (These studies are described in more detail in Chapter 4.)

Investigations on the Marias-Milk Unit were authorized by Congress on September 7, 1966, (80 Stat. 707).

PUBLIC INVOLVEMENT

Public involvement for this study included these groups:

- Milk River irrigators who would benefit from the project
- Dryland farmers in the Big Sandy area whose land would be along a proposed canal route
- Chippewa Cree Tribe on Rocky Boy's Indian Reservation
- Gros Ventre-Assiniboine Tribes on the Fort Belknap Reservation
- Federal and State agencies

Reclamation representatives attended Milk River Irrigation District Board meetings periodically to keep the district up-to-date on the study.

Public meetings have been held in several communities to pass on information, answer questions, and receive comments. Scoping sessions were held to identify environmental issues. Several meetings have been held with the Tribes on Rocky Boy's and Fort Belknap Reservations to discuss the findings of the study as they pertain to interests of the Tribes.

Details of the various meetings and the issues raised can be found in Chapter 6 "Consultation and Coordination."

CHAPTER 2: PROBLEMS AND NEEDS

This study addresses the water shortages in the Milk River Basin. The largest water user along the Milk River below Fresno Reservoir is the Milk River Project, including over 100,000 irrigable acres of lands. Other water users include:

- the Fort Belknap Indian Reservation.

- irrigators along the river and canals with individual contracts with Reclamation (contract pumpers).

- irrigators along the river and canals with water rights junior to the Milk River Project, Fort Belknap Reservation, and contract pumpers (junior water right landowners).

- irrigators along the river and canals with vested water rights established in the Vested Water Right Contract of 1911 (see Water Right Section).

- Bowdoin National Wildlife Refuge.

- Bureau of Land Management stock ponds along the tributaries.

- communities along the river.

- landowners with water rights senior to the Bureau (537 acres).

The water right of each group of water users is different and thereby the degress of water shortages experienced by each varies. This chapter discusses the water rights and water shortages of each group. The alternatives discussed in Chapter 4 were formulated to reduce the water shortages of all water users in the basin.

WATER RIGHTS

International

Allocation of water from the Milk and St. Mary Rivers is governed by the Boundary Waters Treaty of 1909. The treaty states that, during the irrigation season (April 1 to October 31) the United States is entitled to three-fourths of the natural flow of the Milk River at the international boundary (eastern crossing) when the natural flow is 666 ft^3/s or less. Flows over 666 ft^3/s are divided equally between the two countries. During the rest of the year, the natural flow at the eastern crossing is divided equally between the two countries. Waters from the St. Mary River are divided similarly, but Canada receives its three-fourths share during the irrigation season. The waters of the eastern and northside tributaries of the Milk River are split equally.

Montana

The first Milk River water right was filed in 1889. As part of the Milk River Project, Reclamation filed water rights in 1903 and 1908 on all unappropriated water of the Milk River and its tributaries, totaling 51,305 ft^3/s.

Reclamation contracted for the water rights in 1911 of nearly all prior appropriations in the lower Milk River Basin. Known as the Vested Water Right Contract, it included the water supplied to 26,177 irrigated acres or nearly all of the land irrigated in 1912. Under the terms of the contract, prior appropriators conveyed to Reclamation all rights to the water supply. Individual appropriators kept service rights to an additional 537 acres.

Between 1920-1926, seven of the present eight irrigation districts were organized. (The eighth, Dodson Irrigation District, was formed in 1944.) Reclamation issued 145 water-service contracts between 1946-1967 for 11,000 acres along the Milk River mainstem. Contracts were issued to individual pumpers outside the irrigation districts, limited to

2 acre-feet of water per acre. In 1967 all of the districts and the owners of the 11,000 acres under pump contract signed an equalization pact that gave each an equal right to the water stored by the Milk River Project in Lake Sherburne, Fresno and Nelson Reservoirs.

There are an additional 25,000 acres of land which are irrigated outside of the district boundaries, which are not irrigated by contract pumpers. Approximately 55 Montana water rights and use permits (totaling 8,800 acres) have been recorded along the Milk River. Before 1973, 35 water rights for 6,700 acres were established. Twenty water use permits for 2,100 acres have been granted since 1973. All private water rights and permits are considered junior to Reclamation rights. The water right status of the remaining acreage irrigated outside the district boundaries (16,200 acres) is uncertain at present. Water rights in the basin are presently being adjudicated. Adjudication has been given top priority by the State, but completion is not anticipated until at least 1995.

Under the authority provided by State law, DNRC in April 1983 closed sections of the Milk River mainstem to new water appropriations. The closure covers the Milk River mainstem from the river's eastern crossing of the Canada-U.S. border to Vandalia Dam and applies to applications for direct diversions without storage. The river section between the eastern crossing and Fresno Dam is closed each year from January 1 to December 31, inclusive. Sections between Fresno Dam and Vandalia Dam are closed each year from June 15 to September 30, inclusive.

Indian

Water uses on the Blackfeet and Fort Belknap Reservations are protected by unquantified Federal reserved water rights held by the Blackfeet and the Gros Ventre-Assiniboine Tribes. The unquantified water right for the Blackfeet Tribe dates from the establishment of the reservation in 1888 and has been upheld in the 1906 Winter's Doctrine. The Tribe filed suit against the Federal and State Governments in September 1983 to keep their rights from being adjudicated. The case is pending.

The Tribes on the Fort Belknap Reservation have been granted the right to use a minimum of 125 ft^3/s of the Milk River's natural flow under the Winter's Doctrine of 1906, a right senior to other rights or uses. (The Winter's Doctrine gives the reservation the right to expand its water use as the need arises.)

The Chippewa-Cree Tribe on the Rocky Boy's Reservation have claimed the waters of Big Sandy Creek and the headwaters of Beaver Creek. The Tribes on the Fort Belknap and Rocky Boy's Reservations are negotiating with the Montana Reserved Water Rights Compact Commission to quantify reserved water rights on the reservation, but at this time, no compacts have been developed.

IRRIGATION SHORTAGES

Shortages on the Fort Belknap Indian Reservation

The Gros-Ventre Assiniboine Tribes on the Fort Belknap Reservation presently irrigate about 10,425 acres, with a reserved water right under the Winter's Doctrine. The Tribes reserved water right is being negotiated. The quantity of water under the reserved water right will not be known until negotiations are complete. Therefore, the following assumptions were made to estimate the Tribes' current and future shortages.

1. A total of 24,425 acres would be irrigated from the mainstem of the Milk River (10,425 existing acres and 14,000 new acres) under the reserved water right.

2. The Tribes would be entitled to all natural flow of the Milk River and tributaries upstream of the reservation or passing through and one-seventh storage in Fresno Reservoir.

3. The Tribes would continue to improve their existing irrigation system by conservation and a rehabilitation program. Funds for these programs are being provided through the Bureau of Indian Affairs.

Based on these assumptions, the average annual current shortage would be only 4 percent for the existing 10,425 acres. During an extremely dry year, however, the Tribes could be short up to 60 percent. If the Tribes developed 14,000 new acres under their reserved water right, it is estimated they would be short 11 percent on an average annual basis and up to 82 percent during an extremely dry year. The Tribes, therefore, would need a supplemental water supply even with a senior reserved water right to provide a full water supply to a total of 24,425 acres.

Water Shortages of the Milk River Project (Districts and Contract Pumpers)

Milk River Project irrigation water shortages are critical. Under current conditions, average annual shortages are 20 percent of the

average annual demand. When evaluation over a 59-year period, the shortages exceed 10 percent of demand in 6 years out of every 10. While average annual values help illustrate the overall extent of water shortages, they do not show how severe shortages can be. In 1984, for instance, the water shortage exceeded 50 percent of the demand. (See Resources Chapter and Attachment 1 for more detail.)

Contributing to the shortage problem is the poor condition of the irrigation facilities. The Milk River Project was among the first irrigation projects constructed by the Bureau of Reclamation. Many of the 70-year-old facilities are obsolete or in serious need of repair. Modernization and improvement of project facilities would: (1) restore the reliability of the system; (2) conserve water by reducing seepage losses and operational wastes; (3) provide measuring devices for the equitable and efficient distribution of water; (4) provide safety features for protection of human life; (5) restore design capacity to the system to avoid overloading it, thus, reducing the risk of system failure; (6) reclaim agricultural lands affected by seepage losses; (7) improve annual operation and maintenance; and (8) ensure the continued social and economic welfare of the area.

Without rehabilitation, water shortages will continue, and some of the larger features in the system will inevitably fail. As an example, if the Dodson Diversion Dam failed during the irrigation season, extensive crop loss could occur and emergency reconstruction costs would certainly be high.

Along with rehabilitation, improved management of the water supply is also needed in the Milk River Valley to ensure that water is distributed equitably among all eight irrigation districts. Water supplies may be adequate in one district, while other downstream districts may be experiencing severe shortages. Water management presently is hampered by:

1. Lack of measuring devices.

2. Lack of a Board of Control. The irrigation districts operate individually, with a board of directors meeting periodically to discuss problems which are common to all districts; e.g., water supply, OM&R charges.

3. An unreliable water supply.

4. Lack of the incentive to use water efficiently.

5. Lack of capital for maintaining and updating onfarm systems. Present onfarm systems are estimated to be only 27 percent efficient (SCS, 1987).

6. Unadjudicated water rights. After adjudication is completed, a Montana water master could be appointed to enforce water rights.

Current shortages of Milk River Project, contract pumpers, and landowners with junior water rights will increase by an estimated 13,000 acre-feet when the development on the Fort Belknap Reservation takes place under the Tribes' reserved water right. In addition, Canada proposes to use its full legal share of the Milk River mainstem and tributary. Canada proposes to build a reservoir on the Milk River and develop new irrigation. On an average basis, the United States receives 40,000 acre-feet of water beyond its share. Consumption of Canada's entire share will result in an average annual increase in U.S. irrigation shortages of about 15,000 acre-feet (Table 4.1). The loss of an average of 40,000 acre-feet of Canadian water that the U.S. receives. Much of the excess Canadian water is passed during the spring runoff period of high water years. At these times, irrigation demands are low and excess storage in U.S. reservoirs is unavailable. Therefore, at this time it is available, most of the extra Canadian water is not useful for irrigation in the Milk River Basin and is simply passed down the Milk River to its mouth. During drought years when the U.S. experiences severe irrigation shortages, Canada's share of water is small and they utilize most or all of it. The DNRC and the irrigators are presently working with Alberta Environment. There is a possibility that the irrigators may be able to

lease storage in the reservoir, which would offset the increased shortage. Because the planning for the Canadian reservoir is incomplete and a matter for the Province of Alberta, leasing storage in the reservoir was not included in this analyses.

Water Shortages of Landowners with Junior Water Rights

More than 25,000 acres of land are being irrigated under a water right junior to the irrigation districts, contract pumpers, and Fort Belknap Reservation (see "Water Rights"). The landowners involved do not share in the cost of Milk River Project storage facilities, so they rely only on the natural flow of the river, which in most years is inadequate to meet the water requirements of landowners with senior as well as junior water rights. Presently, many of these junior water right holders divert water even when landowners with senior water rights (districts and Tribe) are short.

When adjudication is completed and water rights are enforced, however, these 25,000 acres will be extremely short of water. It is estimated the landowners with junior water rights would be short 100 percent in a dry year like 1984. Ten percent of the time junior water rights would be short 50 percent or more, and 60 percent of the time they would be short 10 percent or more. With such shortages, these lands would probably revert to dryland farming, unless a new water supply is developed.

Water Shortages of Bowdoin National Wildlife Refuge

The Bowdoin National Wildlife Refuge, 7 miles east of Malta in the lower Milk River Valley, encompasses approximately 15,500 acres, including Lake Bowdoin (3,500 surface acres) and Dry Lake (1,300 surface acres). The refuge encompasses 6,500 acres of native grasslands, 200 acres of dense nesting cover, 100 acres of shelterbelts, 2,200 acres of mixed grass/shrub and 6,500 acres of wetlands. Soils in the vicinity are typically saline/sodic clays.

Lack of water to dilute salt concentrations by period flushing or flow through water management has resulted in an accummulation of salts in

Lake Bowdoin and Dry Lake. These salt concentrations have destroyed wetland habitat; cattails and round bulrushes have been replaced by alkali-tolerant species. Submberged plants such as pondweeds and widgeongrass, which flourished during the 1950's, are nearly gone in Dry Lake and are seriously depleted in Lake Bowdoin. As a result of these changes in habitat, waterfowl production (Bowdoin's highest priority management objective) has declined seriously.

Problems caused by the poor quality water of the refuge also occur off-site. Discharges and seeps from the refuge cause problems for downstream irrigators, and alkali dust blows from dried-up ponds and marshes during the summer. The underlying cause is a lack of water to dilute sale concentrations by periodic flushing or flow-through water management.

Mean annual evaporation at Bowdoin is 3.5 feet, which translates to a total of 22,750 acre-feet of water lost annually from the refuge's 6,500 acres of wetlands. With mean annual precipitation supplying about 1 foot of water (or 6,500 acre-feet), irrigation return flows providing another 1,500 acre-feet in a normal season and Reclamation annualy supplying 3,500 acre-feet of stored water (if available beyond irrigation needs), the annual water deficit is 11,000 acre-feet in a normal year, up to 16,000 acre-feet during a dry one. During years of above-average runoff, Beaver Creek flood water reduces the deficit. In normal or dry years (7 or 8 out of every 10), the refuge must depend on water from Fresno Reservoir. This storage water has been unavailable during recent years due to increasing irrigation demands and below normal precipitation. The effects on the refuge have been degraded habitat and reduced waterfowl production. Bowdoin's 1985 production is estimated to be 50 geese and 500 ducks, compared to normal production of 450 geese and 6,000 ducks.

Although management alternatives to deal with Bowdoin's water problems focus on construction and rehabilitation of facilities, a guaranteed water supply is the critical factor. The ideal volume of water needed to meet production objectives is a firm 16,000 acre-feet annually (the amount representing the difference between evaporation and precipitation).

CHAPTER 3: RESOURCES

IRRIGATED LAND

The plan was formulated to provide water to all lands presently irrigated from the mainstem of the Milk River. A total of 138,228 irrigated acres were identified by land classification investigations.

All lands which are provided water from Reclamation facilities must be classified according to Reclamation specifications. (See Land Classification Specifications.) Many of the irrigated lands had been previously classified; the areas that were classified as part of this study include:

- Chinook Division.
- Lands irrigated outside district boundaries. This includes lands irrigated by contract pumpers and landowners with a junior water right.
- Certain lands along the canal from the Missouri River to the Milk River, including Rocky Boy's Reservation.

Milk River Project Lands

The Glasgow and Malta Divisions (including the Dodson Pump Unit) were classified in 1954 and 1955. Arable and irrigated acreages are shown on Table 3.1. Classifications were adequate for planning purposes, except for about 91 acres of Class 5D land on the Dodson Pump Unit which needed resolution. Of the 91 acres, 45 were determined to be arable; the rest are Class 6. The Glasgow and Malta and Chinook Divisions are considered to be at equilibrium 1/ with respect to drainage.

1/ Amount of water going into groundwater equals amount of water going out of groundwater in a year.

Table 3.1
Summary of Lands in Milk River Basin
(acres)

Class	Glasgow	Malta	Dodson Pump	Chinook	Contract Pumpers	Junior Water Rights	Fort Belknap Tribe	Total (rounded)
1	533.12	4,821.77	238.7					
2	2,415.61	6,193.31	652.7					
3	3,664.52	5,690.30						
3x	--	--	--					
4a	7,222.95	4,218.95	47.1					
4b	4,175.27	21,633.78						
5D	Reclassed as irrigable		45					
Arable	18,011.47 3/	42,558.11 3/	983.5 4/	35,000 6/	11,000 5/	26,607 5/	10,425	143,600
Equalization Pact	18,011.76	42,506.00	1/1,006.0	37,274	10,577	0		109,400
Irrigated	15,000.00	42,150.00	1,006.0	34,720	11,529	32,673	10,425	147,500
Served by Project	15,000.00	42,150.00	1,006.0	34,720 2/	10,330 2/	25,000	10,425	138,500 (rounded)

1/ Adjusted to 42,487 acres by 1963 and 1985 reclassification.
2/ Some of the irrigated acres are Class 6. It is assumed that these lands would be irrigated or be retired and irrigation reinstated on irrigable lands. If the landowners in the district do not wish to retire or transfer the water right, the lands will be classed 6W. See 6W definition page 3.3.
3/ 1955 land classification.
4/ 1954 land classification.
5/ Preliminary figures based on 1985-87 classification.
6/ Estimated arable lands within 1957 water-right boundaries.

The Chinook Division was classified in 1957, but no land classification maps have been found. Also, arable acres were only delineated by 40-acre tracts. For these reasons, a semidetailed land classification of the Chinook land was completed in 1985-86. About 35,000 acres are arable within the division boundaries. Drainage was considered a productivity factor, and salinity values were not adjusted to reflect any future drain construction on the irrigated lands.

Lands Irrigated by Contract Pumpers

As discussed under Water Rights Section, the Equalization Act Pact signed in 1967 gave the Milk River Project districts and pump contracts 1/ equal rights to the Milk River natural flow and water stored by the Milk River Project in Lake Sherburne, Fresno and Nelson Reservoirs. The 11,529 acres of lands irrigated by contract pumpers had never been classified and nearly all lands were classified in 1985-1987.

Preliminary figures indicate about 3,000 acres of irrigated lands with Senior Water Rights were classed nonarable in the 1985-1987 survey. Irrigated Class 6 lands holding senior water rights will be handled according to Reclamation Instructions part 512.1.1a(6) which states:

"Class 6 irrigated land with existing water rights will be delineated and designated as class 6W. Every effort should be made to obtain consent for the retirement of 6W lands from irrigation and release or transfer of any water right to which it may be entitled. If this cannot be accomplished, such land will be shown as class 6W and provision made for supplying, under project operation, the amount of water normally available to it under existing rights."

The matter of irrigated class 6 lands will be deferred until the preconstruction survey when the exact location of signed-up lands will be known. For the PFWD all irrigated class 6 lands with senior water rights were included in the project. All class 6 and 6D land with junior rights will not be included in the project.

1/ Landowners with individual pump contracts with the Bureau of Reclamation.

Lands Irrigated by Landowners with Junior Water Rights

According to on-the-ground investigations, about 44,000 acres are irrigated outside of the boundaries of the districts and Fort Belknap Reservation. About 11,000 of these are irrigated by contract pumpers.

The remaining 33,000 acres have an undetermined water right junior to Reclamation and tribal water rights. Of the 33,000 acres, about 25,000 acres are arable. Of the nonarable lands, 3,000 acres are Class 6, 3,500 Class 6D, and about 1,500 acres have not been classified because of the landowners denied access. All lands that were considered undrainable because of shallow barriers or have drain spacing requirements less than 50 feet were designated 6D, except for lands suitable for bluejoint hay (Class 3SX). The nonarable (Class 6 and 6D) lands irrigated by lanowners with junior water rights were not included in the project.

Lands on Fort Belknap Reservation

Irrigated lands on the Fort Belknap Indian Reservation receive a water supply from the natural flow of the Milk River and one-seventh of the storage in Fresno Reservoir. Potentially, irrigable acres are being classified by the Bureau of Indian Affairs as part of the reserved water right negotiation. For this study it was assumed 10,425 acres are presently irrigated and 14,000 additional acres will be developed by the Tribe in the future. The total of 24,425 acres is based on the headgate capacity of the diversion dam for the main canal on the reservation.

Lands Along Canal Route

Since the basin has been closed to new water rights since 1983, no new irrigation was considered for this study. An exception is the lands along the proposed canal route from the Missouri River near Virgelle to the Milk River near Havre. (This canal is described in detail in Chapter 4.) These lands along the canal route include privately-owned land and land on Rocky Boy's Indian Reservation:

	Private Canalside (acres)		Rocky Boy's Reservation (acres)	
	Gravity or Sprinkler	Sprinkler Only	Gravity or Sprinkler	Sprinkler Only
1	1,175	82	505	357
2	1,291	384	1,632	439
3	1,162	364	1,621	144
Total Arable	4,458		4,698	

1985-1987 LAND CLASSIFICATION INVESTIGATION

The primary purpose of the land classification investigation was to determine the acreage of irrigated land suitable for sustained irrigation. This investigation separated arable land from nonarable land. Arable land is land which, when farmed in adequately sized unit for the prevailing climatic and economic setting and provided with the essential farm improvements (removing vegetation and other cover, leveling, soil reclamation, drainage, and irrigation-related facilities), will generate enough income under irrigation to pay all farm production expenses. Arable land will provide a reasonable return to the farm family's labor, management, and capital and pay the operation, maintenance, and replacement costs of associated project irrigation and drainage facilities. In short, the arable area comprises all land delineated in the land classification investigation that will provide sufficient income to warrant consideration for irrigation development. The combined effect of soil texture, soil structure, permeability, depth, salinity, alkalinity, slope, undulations, drainage, cover, stoniness, and field size are some of the major factors considered in arriving at a land class.

Land classes are defined in terms of family income and payment capacity. Arable lands were divided into Classes 1, 2, 3, 3X, S1, S2, and S3 during the 1985-87 investigations. These are economic classifications in which physical differences in land reflect differences in net income.

The standards used are shown on Table 3.2. The main soil deficiencies marked in the survey area are fine soil textures (h factor), salinity (s factor), and sodicity (a factor). Topographic deficiencies include cover removal (c factor), grading requirements (u factor), and small field size (j factor). Onfarm drainage problems were considered a productivity factor (o factor). Irrigated lands were classified considering the present situation and a moderate intensity of management.

Since most lands irrigated by contract pumpers and landowners with junior water rights have been irrigated less than 40 years, drainage was not considered to be at equilibrium at the beginning of the study. Therefore, a drainage investigation was completed to determine the cost of artificial drainage. Lands with sufficient natural drainage for sustained irrigation were identified. Most of the remaining lands will require artificial drainage for continued diversified crop production or slowly degrade over the next 40 years. Certain croplands with clay soils may be converted to bluejoint hay production. The lands were classified based on the current situation. Drainage was considered a productivity factor; costs and benefits of proposed drainage were not considered in the land classification.

Preliminary results of the 1985-87 Land Classification investigation are shown on Table 3.1.

Revised January 1988

Land characteristics	Symbols	CLASS 1 - ARABLE		CLASS 2 - ARABLE		CLASS 3 - ARABLE		CLASS 3W - ARABLE	
		Gravity	Sprinkler 4/	Gravity	Sprinkler	Gravity	Sprinkler	Gravity	Sprinkler
SOILS	a								
Texture (surface)		Sandy loam to clay loam	Same as gravity	Loamy sand to light clay	Same as gravity	Loamy sand to clay.	Same as gravity.	Clay (50 percent or more clay content). Bowbelin type soil.	Same as gravity.
Coarse (sandy)	a	Loamy coarse sand or sand permitted below 30 inches waterholding capacity of 6 or more inches in the upper 40 inches	Same as gravity.	Loamy coarse sand or sand permitted below 20 inches with available water holding capacity of 5 inches or greater in the upper 40 inches	Same as gravity	Loamy coarse sand or sand permitted below 12 inches with available water-holding capacity of 3 inches or greater in the upper 40 inches	Same as gravity	n/a	Same as gravity.
Fine (clayey)	b	Clay not permitted in top 12 inches	Same as gravity	Light permeable clay permitted	Same as gravity	Entire profile may be clay if infiltration rate is adequate for plant moisture require-ments and salt balance	Same as gravity	Entire profile in upper 60 inches may exceed 50% clay if infiltration rate is adequate for plant moisture require-ments and salt balance.	Same as gravity but only occasionally sprinkler irrigated.
Depth of coarse sand, gravel, or cobble	b	Greater than 3 inches with available waterholding capacity of 6 inches or more in the upper 40 inches	Same as gravity	Greater than 2½ inches with available waterholding capacity of 6" inches or greater in the upper 40 inches.	Same as gravity	Greater than 12 inches with available water-holding capacity of 3 inches or greater in the upper 40 inches	Greater than 6 inches with available water-holding capacity of 3 inches or greater in the upper 40 inches	n/a	Same as gravity
Salinity at equilibrium with irrigation water	a	SAR should be less than 10 in fine (clay) texture soils but may range to 15 in coarse (sandy) textured soils	Same as gravity	SAR should be less than 12 in fine (clay) texture soils but may range to 20 in coarse (sandy) textured soils	Same as gravity	SAR should be less than 15 in fine (clay) texture soils but may range to 25 in coarse (sandy) textured soils	Same as gravity.	SAR usually less than 25.	Same as gravity.
Salinity at equilibrium	b	ECe usually less than 4 millimhos per centimeter	Same as gravity	ECe usually less than 4 millimhos per centimeter	Same as gravity	ECe usually less than 8 millimhos per centimeter	Same as gravity	ECe usually less than 15 millimhos per centimeter.	Same as gravity.
Depth to sand/gravel shale or other impervious strata	b	60" plus	Same as gravity	60" plus	Same as gravity	60" plus	Same as gravity	n/a	n/a
TOPOGRAPHY	c								
Gradient	g	0 to 2 percent in general gradient in reasonably large bodies	General gradient not to exceed 8 percent but may include some slope discontinuities or other topographic features which caused this slope limitation were land use considerations would differ from this limitation.	2 to 4 percent in general gradient in reasonable large bodies	Same as Class 1 sprinkler	4 to 8 percent in general gradient in reasonably large bodies.	Same as Class 1 sprinkler.	Usually level to nearly level. 0 to 2 percent in large bodies	Same as gravity.
Irregular perimeter		Regular shaped fields ex-ceeding 5 acres with runs longer than 330 feet. In-creasing irregularity in shape of field will be pen-alized as size increases above minimum.	Minimum size of 20 acres	Regular shaped fields ex-ceeding 5 acres with runs longer than 330 feet. In-creasing irregularity in shape of field will be pen-alized as size increases above minimum.	Same as Class 1 sprinkler.	Regular shaped fields ex-ceeding 2 acres with runs longer than 330 feet. In-creasing irregularity in shape of field will be pen-alized as size increases above minimum.	Same as Class 1 sprinkler.	Same as Class 3 gravity.	Same as Class 1 sprinkler.
Surface leveling or grading	e	Can be accomplished with $20/ac or less per acre	Can be accomplished for $100 or less per acre	Can be accomplished with $40/ac or less per acre	Can be accomplished for $40/ac or less per acre	Can be accomplished with $1,000 or less per acre	Can be accomplished for $750 or less per acre	Can be accomplished with $500 or less per acre.	Can be accomplished for $300 or less per acre.
Surface cobble or stone removal	f	Can be accomplished with $20/ac or less per acre	Can be accomplished for $100 or less per acre	Can be accomplished with $40/ac or less per acre	Can be accomplished for $40/ac or less per acre	Can be accomplished with $1,000 or less per acre	Can be accomplished for $750 or less per acre	Can be accomplished with $500 or less per acre.	Can be accomplished for $300 or less per acre.
Cobble stream and brush removal	i	Can be accomplished with $20/ac or less per acre	Can be accomplished with $40/ac or less per acre	Can be accomplished with $40/ac or less per acre	Can be accomplished for $40/ac or less per acre	Can be accomplished with $1,000 or less per acre	Can be accomplished for $750 or less per acre	Can be accomplished with $500 or less per acre.	Can be accomplished with $300 or less per acre.
DRAINAGE	d								
Cropping Average	b	No uniform drainage problems	Same as gravity	Uniform drainage factors will cause yield reductions up to 2% percent	Same as gravity	Uniform drainage factors will cause yield reduc-tions up to 50 percent	Same as gravity.	N/A	n/a
MAINTENANCE DEVELOPMENT COST 1/		$20/ac or less per acre	$100 or less per acre	$40/ac or less per acre	$40/ac or less per acre	$1,000 or less per acre	$750 or less per acre	$500 or less per acre 2/	$300 or less per acre.
CLASS 6 - NONARABLE		Lands which do not meet the minimum requirements for either gravity or sprinkler arable lands							

1/ Based on Class 1 productivity. Cost of sprinkler equipment is not considered a development cost

2/ Based on most productive Class 3W lands

3/ Locally, Class 3W areas are most suitable for western wheatgrass (bluepoint) hay. Yields average about 2 tons per acre

4/ Arable lands which do not meet the criteria for gravity irrigation

LAND CHARACTERISTICS	Symbols	CLASS 1 - ARABLE		CLASS 2 - ARABLE		CLASS 3 - ARABLE	
		Gravity	Sprinkler 4/	Gravity	Sprinkler	Gravity	Sprin
SOILS	s						
Texture (surface)		Sandy loam to clay loam.	Same as gravity.	Loamy sand to light clay.	Same as gravity.	Loamy sand to clay.	Same a
Coarse (sandy)	v	Loamy coarse sand or sand permitted below 30 inches. Waterholding capacity of 6 or more inches in the upper 48 inches.	Same as gravity.	Loamy coarse sand or sand permitted below 20 inches with available waterholding capacity of 4.5 inches or greater in the upper 48 inches.	Same as gravity.	Loamy coarse sand or sand permitted below 12 inches with available water-holding capacity of 3 inches or greater in the upper 48 inches.	Same a
Fine (clayey)	h	Clay not permitted in top 12 inches.	Same as gravity.	Light permeable clay permitted.	Same as gravity.	Entire profile may be clay if infiltration rate is adequate for plant moisture requirements and salt balance.	Same
Depth of coarse sand, gravel, or cobble	k	Greater than 30 inches with available waterholding capacity of 6 inches or more in the upper 48 inches.	Same as gravity.	Greater than 20 inches with available waterholding capacity of 4.5 inches or greater in the upper 48 inches.	Same as gravity.	Greater than 12 inches with available water-holding capacity of 3 inches or greater in the upper 48 inches.	Great with holdi 3 inc the u
Sodicity at equilibrium with irrigation water	a	SAR should be less than 10 in fine (clay) texture soils but may range to 15 in coarse (sandy) textured soils.	Same as gravity.	SAR should be less than 12 in fine (clay) texture soils but may range to 20 in coarse (sandy) textured soils.	Same as gravity.	SAR should be less than 15 in fine (clay) texture soils but may range to 25 in coarse (sandy) textured soils.	Same
Salinity at equilibrium	s	ECe usually less than 4 millimhos per centimeter.	Same as gravity.	ECe usually less than 6 millimhos per centimeter.	Same as gravity.	ECe usually less than 8 millimhos per centimeter.	Same
Depth to sandstone, shale, or other impervious strata	b	60" plus.	Same as gravity.	60" plus.	Same as gravity.	60" plus.	Same a
TOPOGRAPHY	t						
Gradient	g	0 to 2 percent in general gradient in reasonably large bodies.	General gradient not to exceed 8 percent but may include small escarpments or other topographic features which exceed this slope limitation when land use considerations would dictate this inclusion.	2 to 4 percent in general gradient in reasonably large bodies.	Same as Class 1 sprinkler.	4 to 6 percent in general gradient in reasonably large bodies.	Same sprin
Irrigation pattern	i	Regular shaped fields exceeding 8 acres with runs longer than 400 feet. Increasing irregularity in shape of field will be permitted as size increases above minimum.	Minimum size of 20 acres.	Regular shaped fields exceeding 5 acres with runs longer than 300 feet. Increasing irregularity in shape of field will be permitted as size increases above minimum.	Same as Class 1 sprinkler.	Regular shaped fields exceeding 2 acres with runs longer than 100 feet. Increasing irregularity in shape of field will be permitted as size increases above minimum.	Same sprin
Surface leveling or grading	u	Can be accomplished with $200 or less per acre.	Can be accomplished for $100 or less per acre.	Can be accomplished with $600 or less per acre.	Can be accomplished for $400 or less per acre.	Can be accomplished with $1,000 or less per acre.	Can for acre
Surface cobble or stone removal	r	Can be accomplished with $200 or less per acre.	Can be accomplished for $100 or less per acre.	Can be accomplished with $600 or less per acre.	Can be accomplished for $400 or less per acre.	Can be accomplished with $1,000 or less per acre.	Can for acre
Cover (trees and brush) removal	c	Can be accomplished with $200 or less per acre.	Can be accomplished for $100 or less per acre.	Can be accomplished with $600 or less per acre.	Can be accomplished for $400 or less per acre.	Can be accomplished with $1,000 or less per acre.	Can for acre
DRAINAGE	d						
Onfarm drainage	o	No onfarm drainage problems.	Same as gravity.	Onfarm drainage factors will cause yield reductions up to 25 percent.	Same as gravity.	Onfarm drainage factors will cause yield reductions up to 50 percent.	Same
PERMISSIBLE DEVELOPMENT COST 1/		$200 or less per acre.	$100 or less per acre.	$600 or less per acre.	$400 or less per acre.	$1,000 or less per acre.	$70
CLASS 6 - NONARABLE		Lands which do not meet the minimum requirements for either gravity or sprinkler arable lands.					

1/ Based on Class 1 productivity. Cost of sprinkler equipment is not considered a development cost.
2/ Based on most productive Class 3X lands.
3/ Locally, Class 3X lands are most suitable for western wheatgrass (bluejoint) hay. Yields average about 2 tons per acre.
4/ Arable lands which do not meet the criteria for gravity irrigation.

TABLE 3.2

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION

COMBINED GRAVITY-SPRINKLER IRRIGATION LAND CLASSIFICATION SPECIFICATIONS
MILK RIVER PROJECT, MONTANA

	CLASS 3X - ARABLE	
	Gravity	Sprinkler
ty.	Clay (50 percent or more clay content). Bowdoin type soil.	Same as gravity.
ty.	N/A	Same as gravity.
ty.	Entire profile in upper 60 inches may exceed 50% clay if infiltration rate is adequate for plant moisture requirements and salt balance.	Same as gravity but only occasionally sprinkler irrigated.
inches le water- city of greater in inches.	N/A	Same as gravity.
ty.	SAR usually less than 25.	Same as gravity.
ty.	ECe usually less than 15 millimhos per centimeter.	Same as gravity.
ty.	N/A	N/A
s 1	Usually level to nearly level. 0 to 2 percent in large bodies.	Same as gravity.
s 1	Same as Class 3 gravity.	Same as Class 1 sprinkler.
plished less per	Can be accomplished with $500 or less per acre.	Can be accomplished for $300 or less per acre.
plished less per	Can be accomplished with $500 or less per acre.	Can be accomplished for $300 or less per acre.
plished less per	Can be accomplished with $500 or less per acre.	Can be accomplished with $300 or less per acre.
vity.	N/A	N/A
s per e.	$500 or less per acre. 2/	$300 or less per acre.

The Milk River Simulation Model

Determining historical and projected future water shortages in the Milk River Basin is the most critical element for evaluating proposed plans. The amount and frequency of shortages in the basin were estimated from a computer simulation model developed by the Department of Natural Resources and Conservation (DNRC) and Reclamation, using the format of the OPSTUDY river basin model. Operated on a monthly time-step over a 59-year period (1927-1985), the Milk River model estimated streamflows, irrigation diversions, and reservoir contents.

Major data required by the model included historic streamflows, crop irrigation requirements, irrigation efficiencies, canal capacities, and irrigated acreages, as well as reservoir capacities, area capacity tables, and seepage and evaporation rates. Details of the model can be found in Attachment 1 in the back of this report.

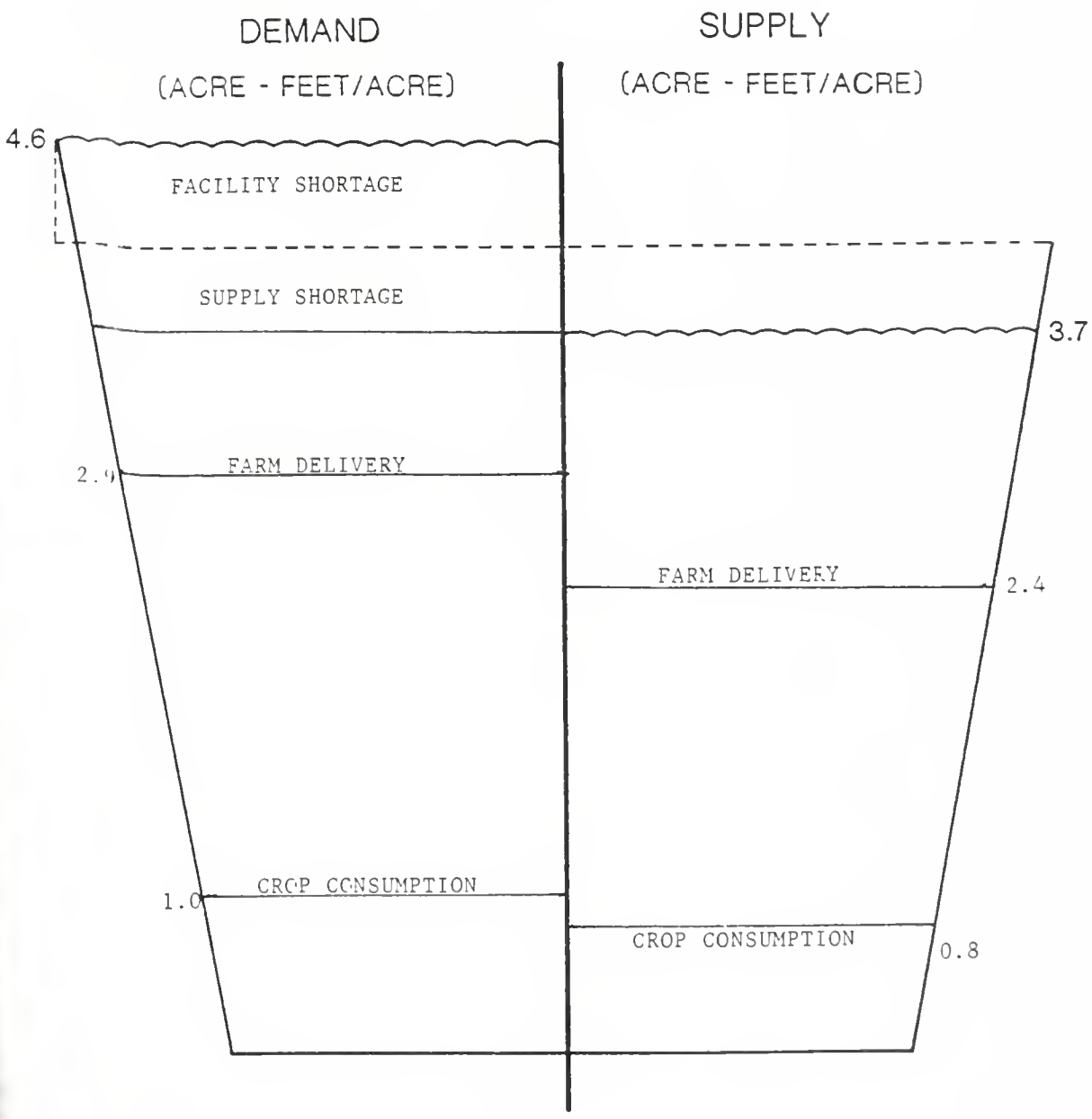
The model showed that a mean annual diversion of 4.6 acre-feet/acre would be necessary to satisfy the 1 acre-foot/acre crop irrigation requirement for current conditions. The estimated mean annual diversion is currently only 3.7 acre-feet/acre, with 0.8 acre-feet/acre being delivered to the crop root zone. There is, therefore, a mean annual diversion shortage of 0.9 acre-feet/acre, which translates into a 0.2 acre-feet/acre shortage in crop water requirement.

Figure 3.1 illustrates how insufficient water supply and inaedequate (facility) capacity in project facilities contribute to the irrigation shortages of the Milk River Project. The figure depicts an average canal cross section of the Milk River Project. As shown, historic average diversion demand exceeds the canal capacity and the increment of demand above the canal capacity (0.5 acre-foot/acre) represents the mean annual facility shortage. The historic average water supply, however, is not sufficient to fill the canal and thus a water supply shortage (0.4 acre-foot/acre), also contributes to the problem.

Figure 3.1

IRRIGATION SHORTAGES

CURRENT CONDITIONS



The relatively high facility shortage, have been substantiated through discussions with ditch riders and irrigators who confirm that many canals cannot convey enough water to satisfy all irrigation in the lower reaches.

Under current conditions (present level irrigated acreage under historic climatological conditions for the period 1927-85) the average annual demand 1/ for districts, contract pumpers, landowners with junior water right acres, and Tribes on Fort Belknap Reservation is estimated to be 632,700 acre-feet. The average annual facility shortage is 62,900 acre-feet (10 percent) and water supply shortage is 61,200 acre-feet (9 percent). The estimated shortage in 1984 is 289,700 acre-feet. Shortages exceed 10 percent of the demand 6 out of 10 years.

1/ This demand is the total diversion required at the headgates of the canals.

CHAPTER 4: PLAN FORMULATION

PLAN FORMULATION OVERVIEW

At the onset of this study, the problem in the Milk River Basin appeared to be an inadequate water supply, which could be alleviated with a source of supplemental water. Offstream storage sites and importing water from Tiber Reservoir, Missouri River, or Fort Peck Reservoir were evaluated. (These alternative sources of water are presented at the end of this chapter for information.)

Of these sources of supplemental water, only the Virgelle-Milk Canal Alternative was economically justified and warranted further study. Water would be pumped from the Missouri River near Virgelle and convyed to the Milk River near Havre. The quantity of water imported would be adequate to alleviate current and future shortages. As explained earlier in the Problems and Needs Chapter, the current average annual water supply shortages are expected to increase about 28,000 acre-feet in the future when the Canadians and Fort Belknap Reservation Tribes use their legal share of the Milk River water.

As the water supply problems of the basin were evaluated in more detail and additional data were collected, it became evident that the water shortages are caused by more than an inadequate water supply. The aging canals of the Milk River Project do not have adequate capacity to convey sufficient water to meet the crop demands with current system efficiencies. (The system efficiencies are estimated at 17 percent. See Water Resources Section.) Thus even if an adequate basin water supply were available, many of the irrigators would not receive an adequate water supply to meet crop demands. In addition, measuring devices at all farm turnouts and laterals and a Joint Board of Control are needed for equitable distribution and management of the existing supply.

Therefore, a three-phase plan was formulated that would include better management of the water available, rehabilitation of the entire system (conveyance and onfarm facilities) to reduce headgate demand to within canal capacity, and a new water supply.

Phase 1 has been initiated. A Joint Board of Control is being established to coordinate the basin-wide management of water, and St. Mary Canal is being restored to its original design capacity.

The Joint Board of Control, which would be made up of irrigation district supervisors elected by the water users, would coordinate and consolidate irrigation operation and maintenance. This would result in more efficient and effective use of water, equipment, and district staff.

The St. Mary Canal diverts St. Mary River water to the Milk River. This canal is undergoing restoration to obtain more of the U.S. share of water, as apportioned by the Boundary Waters Treaty of 1909. Rehabilitation of the canal could reduce average annual shortages by an estimated 16,000 acre-feet.

Phase 2 would focus on reducing demand at canal headgates by improving conveyance efficiencies, through rehabilitation of the canal and laterals, and increasing onfarm irrigation efficiencies. This would enable the canals to carry enough water to meet crop needs. Phase 2 includes three elements--Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement. In addition to conserving water, implementation of these three elements would improve distribution of water, increase crop production, reduce labor, improve operation and maintenance, and permit reclamation of lands affected by canal seepage.

Reclamation is completing Rehabilitation and Betterment (R&B) Reports for Malta and Glasgow Divisions, which include all three elements in Phase 2. The Department of Natural Resources and Conservation is completing similar reports for the Chinook Division and Dodson Pumping Unit. The cumulative effect of implementing Phase 2 elements for the entire Milk River Basin are presented in this chapter.

Phase 2 costs were estimated assuming only the districts and contract pumpers would participate in the three elements. These irrigators would also be the primary beneficiaries. Until the water rights of the basin have been adjudicated and a water master has been appointed, landowners

with junior water rights will continue to irrigate even during periods when the water supply is only adequate for landowners with senior water rights. Under this operation the Milk River Project districts, contract pumpers, and landowners with junior water rights should have an adequate water supply. It is estimated that average annual shortages would be about 3 percent, and shortages that exceed 10 percent of demand would only occur 1 of 10 years. (See Effects on Water Supply for Phase 2.) The inequity of this operation is that the landowners with junior water rights are receiving a water supply from the Milk River Project facilities (St. Mary Canal, Sherburne Lake, Fresno Reservoir, and Nelson Reservoir) at no cost. One way to resolve this inequity is for all irrigators to share the available water and to share all costs to provide the water. This would require agreement by all parties and negotiation of a new repayment contract, similar to the equilization pact of 1967 (see Water Rights Section).

Another way to resolve the inequity is to complete the adjudication of the Milk River Basin water rights, and to enforce the water rights by appointment of a water master. This would result in a very inadequate water supply for the landowners with junior water rights. Sixty percent of the time, their water shortages would exceed 10 percent of their demand. In extremely dry years, they would be completely without water. With these extreme conditions, landowners with junior water rights would probably revert to dryland farming.

Phase 3 was formulated to provide an adequate water supply to the landowners with junior water rights, Gros Ventre-Assiniboine Tribes on Fort Belknap Reservation, Bureau of Land Management stockwater ponds (through exchange with tributary water), Bowdoin National Wildlife Refuge, and the town of Chinook. The Preferred Plan is a 230 ft^3/s pumping plant on the Missouri River near Virgelle and a canal from the Missouri to the Milk River near Havre, a distance of 46 miles. Water would be provided to landowners along the canal, including the Chippewa Cree Tribe on the Rocky Boy's Reservation.

Phase 3 is presented in detail in this chapter.

DESCRIPTION OF PHASE 1

Elements of Phase 1

Phase 1 is being completed by the Milk River irrigators. This phase includes formulation of a Joint Board of Control and restoring St. Mary Canal to its original design capacity.

St. Mary Canal Restoration

Sherburne Dam, St. Mary Diversion Dam, and St. Mary Canal were constructed in the 1910's. Lake Sherburne behind Sherburne Dam stores St. Mary River water. St. Mary Canal begins at St. Mary Diversion Dam on the west side of St. Mary River and discharges into North Fork of the Milk River. The canal is 29 miles long. The original design capacity was 850 cubic feet; present capacity is estimated at 700 cubic feet.

St. Mary River is a critical element of the water supply available in the Milk River Basin. The mean annual flow of the international border is 267,150 acre-feet/year. Of this, an average of 140,000 acre-feet is contributed from the St. Mary River Basin. Therefore, the Milk River Project irrigators are restoring the St. Mary Canal to its original design capacity, by reshaping the canal banks. This work is being accomplished as part of their annual operation and maintenance program. The work should be completed by 1991.

Joint Board of Control

The Milk River irrigators are in the process of forming a Joint Board of Control. The Board will be made up of representatives elected by the water users. Ideally the Board will be organized so it can be expanded. Initially the Board could administer water usage and the Milk River Project reserved works. This would allow the private and Federal sectors along the Milk River to work together for everyone's benefit. The Board's authority could be expanded in time to include operation and maintenance of all of the facilities.

Effects of Phase 1

The Joint Board of Control will result in a more efficient use of water, equipment, and district staff.

The restoration of St. Mary Canal will reduce the average annual shortages in the basin by 16,000 acre-feet.

Costs of Phase 1

The St. Mary Canal is being restored through a special assessment which has been included in the annual Milk River Project OM&R for a period of 5 years.

The cost for forming the Joint Board of Control has not been estimated.

DESCRIPTION OF PHASE 2

("Future Without the Project Condition" or No Action Alternative)

Phase 2 includes three elements being pursued under the R&B Program -- Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement. These three elements are summarized below and described in more detail in Attachment 3 to this report and in the Reports for Proposed Rehabilitation and Betterment Program for Malta Division, Glasgow Division, Chinook Division and Dodson Pump Unit.

Phase 2 represents what could happen if the basin water supply were not increased in Phase 3. Therefore, Phase 2 is used as a base for comparison of the economic, environmental, and social effects of Phase 3. It is referred to as the Future Without the Project Condition (without Phase 3), or No Action Alternative in the PFWD. Phase 2 also encompasses those activities accomplished under Phase 1.

Elements of Phase 2

Rehabilitation and Betterment

The facilities of the Milk River Project (Malta, Glasgow, and Chinook Divisions) would be rehabilitated. This includes relocating, rebuilding, or enlarging reaches of canals; lining canals with compacted earth, PVC, or concrete; replacing canal structures; realigning or deepening existing drains; constructing new drains; lining laterals or installing in pipe; and installing measuring devices. This work would focus on the most serious problems.

Construction and Rehabilitation

This element would be an expansion of the Rehabilitation and Betterment element. The project distribution system (structures, canals, laterals and drains) would be upgraded. Obsolete structures such as diversion dams would be modified or replaced. Measuring devices would be installed on all farm turnouts and laterals.

Onfarm Efficiency Improvement

Onfarm improvements (leveling fields, raising border dikes, lining ditches, installing gated-pipe, sprinklers, and concrete-lined head ditches with automated control) would be coupled with improved irrigation scheduling and operational changes.

Presently, the Soil Conservation Service (SCS) works with the operators in the basin to improve onfarm irrigation efficiencies. The Bureau of Reclamation would want to maintain the relationship the SCS has with the farmers. To implement the Onfarm Efficiency Element, the Bureau suggests that Reclamation would transfer the funds to the SCS through a Memorandum of Understanding (MOU). Annually, the SCS in cooperation with Reclamation and the Milk River Joint Board of Control would agree on the onfarm improvements to be done that year. After agreement the funds would be transferred to the SCS.

Each irrigation district would receive onfarm improvement funds based on the acres in their district as compared to the total project. For example:

Glasgow District	15,000 acres
Total Project	103,000 acres

$$\frac{15,000}{103,000} = 15 \text{ percent}$$

Glasgow District would receive 15 percent of the onfarm funds.

Effects of Phase 2

These three elements will upgrade the distribution system, improve drainage and help drain extensive seeps, improve distribution of available water, improve operation and maintenance, increase crop production, decrease labor required for farm operations, and reduce demands at the headgates so canals are capable of providing water to crops.

Effects on Water Demand and Shortages

To evaluate the effect of each element of Phase 2 on the water supply, a sequence of events was selected:

1. Present condition (historical)
2. Restoration of St. Mary Canal (St. Mary)
3. Canadian development of their full share of Milk River water supply (Canadian)
4. Development of 14,000 additional acres on Fort Belknap Reservation (Indian)
5. Implementation of Rehabilitation and Betterment element (R&B)
6. Implementation of Construction and Rehabilitation element (C&R)
7. Implementation of Onfarm Efficiency Improvement element (Onfarm)
8. Adjudication Completed and Water Rights Enforced (Adjudication)

Table 4.1 and Figure 4.1 show the effect of this sequence of events on the demands and shortages for the districts, contract pumpers, and junior water right landowners. Table 4.2 and Figure 4.2 show the effect on the demands and shortages of the Fort Belknap Reservation Tribes. The demands and shortages are based on 138,500 acres of land presently irrigated and 14,000 new acres on Fort Belknap Reservation:

Water User	Acres
Districts and Contract Pumpers	103,206
Landowners with Junior Water Rights	25,000
Fort Belknap Indian Reservation	10,425
Existing Irrigated Acres (Rounded)	138,500
New Acres on Fort Belknap Indian Reservation	14,000
Future Irrigated Acres	152,500

Data used to compute the shortages were based on the best available information. Accurate data on water usage in the basin is difficult to obtain due to lack of project measuring devices. As part of the rehabilitation program, measuring devices will be installed at all canal and lateral headworks and at all turnouts. These will help the equitable distribution of water and will also provide data to compute efficiencies for the system.

The average annual demand is based on the average annual crop irrigation requirement (CIR) and conveyance and onfarm efficiencies. For example, if the CIR were I acre-foot/acre, the onfarm efficiency 27 percent and the conveyance efficiency 64 percent, the diversion demand at the headgate would be 5.8 acre-feet per acre (1 divided by (.27 x .64)]. This means that 5.8 acre-feet per acre would have to be diverted to deliver 1 acre-foot to the crop. If the diversion demand is greater than the canal capacity, the increment of demand above the canal capacity represents the "facility shortage." If the water supply were insufficient to fill a canal, there would be a "water supply shortage." (See Attachment 1, "Water Supply Simulation Model" for more details.) Both the water supply and facility shortages represent a shortage to the crop.

District, Contract Pumpers and Junior Water Right Landowners Shortages.--As shown on Table 4.1 and Figure 4.1, restoring St. Mary Canal will decrease

the average annual water supply shortage of the districts, contract pumpers and landowners with junior water rights by about 16,000 acre-feet (59,700 minus 43,800 acre-feet). Canadian and Indian development will increase their water supply shortage by about 28,000 acre-feet (from 43,800 to 71,800 acre-feet). This 71,800 acre-foot water supply shortage coupled with the 62,900 acre-foot facility shortage (caused by water demands greater than canal capacity) will result in a total shortage of 134,700 acre-feet or about 23 percent of the total demand. The Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement elements will reduce the average annual demand (at the canal headgates) from 593,600 to 344,000 acre-feet or 42 percent improvement. The canals would have adequate capacity to carry the water needed to meet the crop irrigation demands; there would be essentially no facility shortage and the average water supply shortage would only be 3 percent.

In an extremely dry year, the shortage would be 103,000 or 24 percent after Phase 2 is implemented. Extreme shortages (greater than 10 percent of demand) would occur only 1 out of 10 years compared to 6 out of 10 years currently.

The water supply at present is used by all irrigators in an upstream-downstream order, regardless of right. The water supply is not distributed based on water rights because the water rights have not been adjudicated, no water master has been appointed to enforce water rights, there are few measuring devices, and there is no joint board of control to manage water distribution in the basin.

Enforcement of adjudicated water rights would reduce shortages for district and contract pumpers another 50,000 acre-feet during dry years (see lines 4 and 5 on Table 4.1). With these shortages the districts and contract pumpers would not need an additional water supply beyond Phase 2.

With Phase 2 in place there would still be shortages in the basin 8 out of 10 years. After adjudication of water rights are enforced, the 25,000 acres of land irrigated under junior water rights would bear these

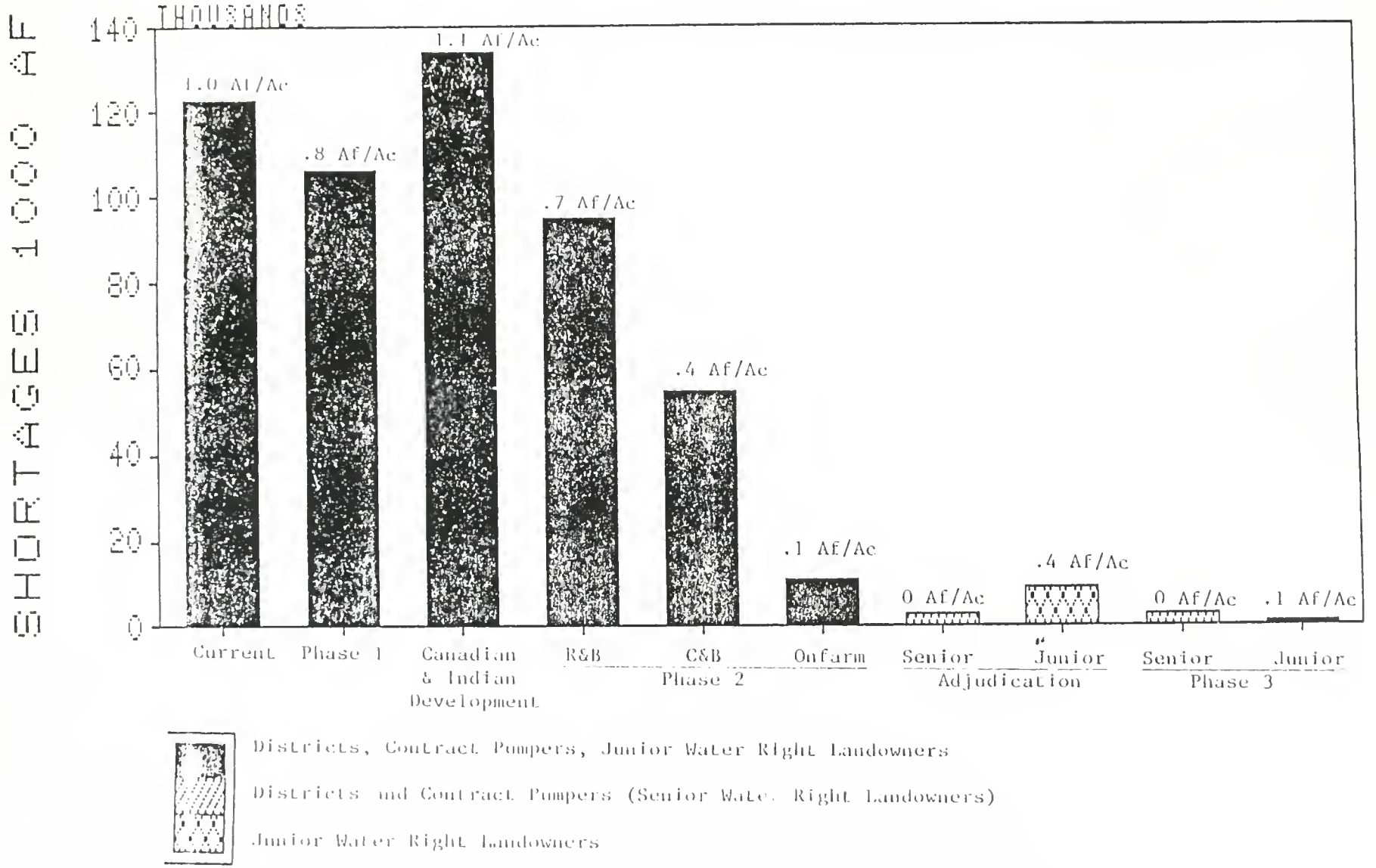
Table 4.1
SUMMARY OF CUMULATIVE EFFECTS OF THREE-PHASE PLAN
ON DEMANDS AND SHORTAGES OF DISTRICTS, CONTRACT PUMPERS, JUNIOR WATER RIGHT LANDOWNERS

Scenario	Average Annual Demand (Acre-feet)	Average Annual Facility Shortage (Acre-feet)	Average Annual Water Supply Shortage (Acre-feet)	Maximum Water Supply Shortage 1984 (Acre-feet)	Frequency of Water Supply Shortages that Exceed 10% of Demand
Before Adjudication Enforced - Districts, Contract Pumpers and Junior Water Right Landowners					
1. Current	593,600	62,900	59,700	266,700	6 years out of 10
2. Phase 1 Complete	593,600	62,900	43,800	249,400	6 years out of 10
3. Canadian, Indian Development	593,600	62,900	71,800	243,100	7 years out of 10
4. Phase 2					
R&B	532,000	38,300	56,300	230,590	5 years out of 10
R&B and C&B	454,500	17,100	36,900	187,900	4 years out of 10
R&B, C&B and Onfarm	344,000	1,600	10,300	103,000	1 year out of 10
5. Adjudication Enforced					
Districts and Contract Pumpers	299,600	1,600	1,200	51,000	1 year out of 10
Junior Water Right Landowners	44,400	-----	9,100	52,000	6 years out of 10
6. Phase 3 District and Contract Pumpers	299,600	1,600	1,200	51,000	1 year out of 10
Junior Water Right Landowners	44,400	-----	1,600	17,500	1 year out of 10

FIGURE 4.1

WATER SUPPLY AND FACILITY SHORTAGES

AVERAGE



shortages. Diversions for these 25,000 acres would be reduced or completely shut off. In 6 out of 10 years, shortages to these lands would be over 10 percent. In 1 out of 10 years the shortages would be over 50 percent. In years such as 1941 and 1984 these lands would be completely without water. With these extreme shortages, the landowners with junior rights should revert to dryland operations.

Fort Belknap Reservation Shortages.--Table 4.2 and Figure 4.2 shows the shortages for the Fort Belknap Reservation Tribes. Assuming the Tribes were entitled (under their reserved water right) to all natural flows of the Milk River and tributaries upstream of or passing through the reservation, the average annual water shortage would be 6,200 acre-feet or 11 percent for 24,425 acres (see line 5 of Table 4.2). In a year such as 1984 with limited natural flow, shortages would exceed 80 percent. This level of shortages assumes the Tribes will continue to update their existing system through a rehabilitation program similar to Phase 2 proposals. Funding has been obtained through the Bureau of Indian Affairs for rehabilitation in the past.

Other Water Users Shortages.--If the system were operated very stringently, an additional 3,700 acre-feet could be provided to Lake Bowdoin on an annual basis without affecting the district shortages. For Phase 3 analysis it was assumed Lake Bowdoin would still need 15,700 acre-feet additional water, town of Chinook 400 acre-feet, and Bureau of Land Management 7,500 acre-feet.

Effects on Environment

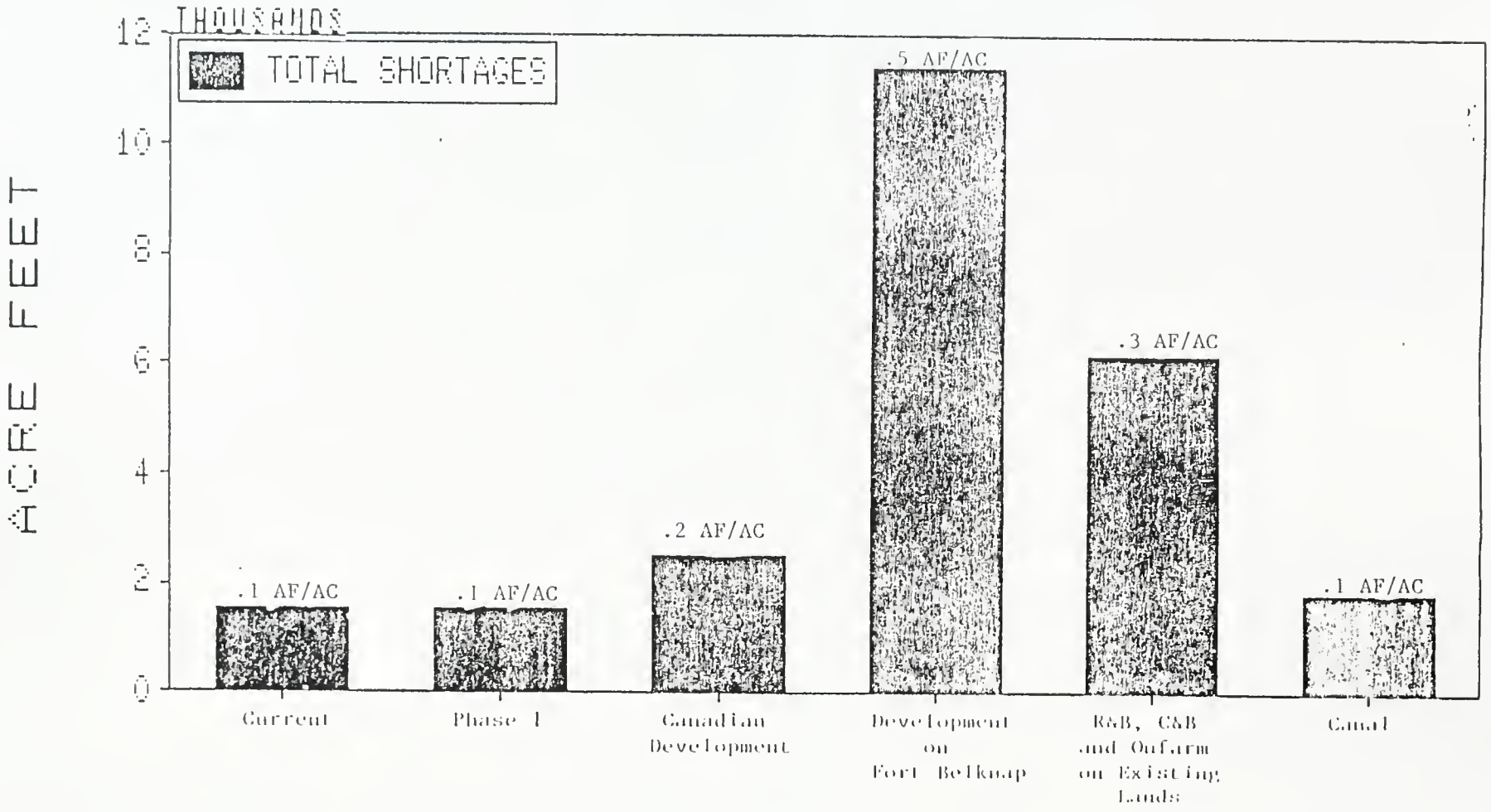
Canal, lateral and drain rights-of-ways offer riparian habitat and vegetative cover for many species. The most critical effect of Phase 2 on terrestrial species will be due to elimination of seeped areas. Over the years, seepage from canals has created several large seeps that provide important habitat. Improving the delivery systems will help eliminate seepage, consequently drying up these artificially created wetlands.

Table 4.2
SUMMARY OF CUMULATIVE EFFECTS OF THREE PHASE PLAN ON DEMANDS AND SHORTAGES OF FORT BELKNAP INDIAN RESERVATION TRIBES

Scenario	Average Annual Demand (Acre-feet)	Average Annual Facility Shortage (Acre-feet)	Average Annual Water Supply Shortage (Acre-Feet)	Maximum Water Supply Shortage 1984 (Acre-Feet)	Frequency of Water Supply Shortages that Exceed 10% of Demand
1. Current	39,900	0	1,500	23,900	1 year out of 10
2. Phase 1 Complete	39,900	0	1,500	23,900	1 year out of 10
3. Canada Development	39,900	0	2,500	25,100	2 years out of 10
4. Development of 14,000 acres on reservation	71,700	1,400	11,400	60,300	5 years out of 10
5. Phase 2 (R&B, Onfarm, C&R)	56,300	0	6,200	46,400	3 years out of 10
Adjudication Enforced					
Phase 3	56,300	0	1,800	26,000	1 year out of 10

WATER SUPPLY AND FACILITY SHORTAGES

FORT BELKNAP INDIAN RESERVATION



Although threatened/endangered species such as the piping plover, peregrine falcon, black-footed ferret and bald eagle may occur in the area, none will be affected by Phase 2.

No known cultural resources should be affected, but intensive field inventories may have to be conducted in undisturbed areas where new construction will take place. Since the Milk River Project is one of the oldest Federal irrigation projects in the Nation, the historical significance of certain project features may also have to be evaluated.

The following wildlife mitigation measures have been recommended by the U.S. Fish and Wildlife Service (USFWS) in its "Planning Aid Memorandum" prepared for the R&B and C&R Programs on the Glasgow, Malta, and Chinook Divisions.

1. Areas should be managed for wildlife to compensate for habitat lost as a result of Phase 2. These include 2,755 acres in the Beaver Creek area, 1,340 acres next to Nelson Reservoir, 558 acres near the Dodson Canal, 400 acres west of Vandalia Diversion Dam, and 5,600 acres in Lonesome Lake area.

2. Some newly lined canals and laterals could entrap deer. Escape mechanisms are recommended for every 1/4 mile in the initial reaches of laterals DN-104, DS-50 and DS-140. The Vandalia South Canal should be monitored to see if deer are trapped. If so, the canal should be fenced.

Phase 2 will not result in significant changes in flow regimens of the Milk River. Impacts to fishery resources associated with historic dewatering and low flows in the Milk River will continue. Operation of Fresno and Nelson Reservations under Phase 2 should result in a general improvement in fishery habitat. Changes in waterfowl use of the river or around Fresno Reservoir are not expected.

Social Effects

Phase 2 would help alleviate water shortages in the basin; however little change in economic and social conditions is anticipated in the area. Agriculture will continue to be the primary basic industry, with principal crops including alfalfa, barley, and wheat. Cattle grazing would continue to be an integral part of most operations.

Although overall population in the area is projected to increase by about 10 percent by the year 2000, all increases will take place, as has historically been the case, in the larger cities and towns, such as Great Falls, Havre, Fort Benton, Malta, Glasgow, etc. However, the actions in Phase 2 to help alleviate water shortages should help to decrease the historical rate of rural population loss.

Employment, commensurate with population trends, will continue to follow area historical patterns of increases in urban areas, and decline in rural areas. Unemployment on the Fort Belknap and Rocky Boy's Reservations, currently at about 70 percent, will continue at relatively high levels.

Per capita income will remain below the national average. Although current dollar income for the area is expected to increase by about 60 percent by the year 2000, income in the agriculture sector is expected to increase by only 35 percent over the same period (Department of Commerce, 1970). Phase 2 will provide increased direct agricultural income of about $6.1 million, and indirect income of about $2.4 million. Annual equivalent economic costs of Phase 2 would be about $8.7 million.

As of the 1980 census, there was a housing vacancy rate of about 20 percent within the five counties encompassing the project area. It is expected that a comparable rate would continue into the foreseeable future due to the continued depressed state of rural economics and long-term trend of population moving away from the farm and into the towns and cities. Typical of most rural areas in the State, provision of social and medical services will continue to be difficult, due to distances traveled and restricted social and cultural opportunities.

Costs of Phase 2

Estimated construction costs for the three elements in Phase 2 are as follows:

Elements	Cost
Rehabilitation and Betterment	$ 14,200,000
Construction and Rehabilitation	68,400,000
Onfarm Efficiency Improvement	$ 18,600,000
TOTAL	$101,200,000

In addition, onfarm drains should be installed as needed on contract pump lands. Drainage investigations show that about $12 million is required for onfarm drains over the next 40 years. The drains could be constructed under the Drainage and Minor Construction (D&MC) Program.

Financial Analysis of Phase 2

The districts' ability to repay a loan for Phase 2 is demonstrated through the use of a farm budget analysis. This analysis shows that no payment capacity exists, as traditionally measured when net farm income is reduced to provide allowances for operator and family labor, return to management, and return to equity. However, the landowners can repay the loans if they are willing to obligate part of their disposable income for this repayment. The average disposable income is $19,500 per farm. Allowing $18,108 for family living, the average payment would be $1,392 per farm, or $4.67/acre (based on 298 irrigated acres/farm). This level of funding would limit rehabilitation of the system to the Rehabiliation and Betterment element of Phase 2.

The irrigators want to financially integrate complete rehabilitation of the system (Phase 2) into the P-S MBP. The cost of the rehabilitation elements exceeding the irrigators willingness to pay would be repaid by power revenues from the Pick-Sloan Missouri Basin Program (P-S MBP). This integration into the P-S MBP would require the irrigators to seek Congressional authorization for its accomplishment.

The P-S MBP program was initially established as a multi-objective plan for flood control, irrigation, power, fish and wildlife, and navigation. Hydropower and flood control aspects of the plan have been developed with success. With regard to irrigation, the P-S MBP called for 137 irrigation units to serve over 5 million acres of land. Only 12 percent of the full service land has been developed and less than 34 percent of the supplement supply is receiving water. Montana has received irrigation development of 47,782 acres of the proposed 967,130 included in the original plan, or about 5 percent of the proposed development.

DESCRIPTION OF PHASE 3
(Virgelle-Milk Canal)

Phase 3 was formulated to provide a water supply to water users that would experience excessive water shortages after Phase 2 is implemented. These include the landowners with junior water rights, Tribes on Fort Belknap Reservation, Bureau of Land Management stockwater ponds, Bowdoin National Wildlife Refuge, irrigators along the Virgelle-Milk Canal (private and Rocky Boy's Reservation), and communities along the Milk River. Three canal capacities were evaluated: 230-, 200-, and 175-ft^3/s canal. A 230-ft^3/s canal would provide water to all water users listed above. This is referred to as the Preferred Canal Alternative. A 200-ft^3/s canal would provide adequate water for all water users except private landowners along the canal. With a 175-ft^3/s canal private landowners along the canal and lands on the Rocky Boy's Reservation would not receive a water supply.

As stated earlier, the DNRC and Milk River irrigators are pursuing the potential of leasing storage in a proposed reservoir in Alberta as a potential alternative. Planning for this reservoir is a matter for the Province of Alberta. This report focuses only on plan selection for the canal alternative for Phase 3. Appropriate planning documents were prepared for Phase 1 and 2 by the responsible entities, as well as required NEPA compliance documents. NEPA compliance for Phase 3 will be accomplished via the Planning Report/Draft Environmental Statement (PR/DES) that will be prepared when the PFWD is finalized.

Virgelle-Milk 230-ft^3/s Canal Alternative
(Preferred Canal Alternative)

Features of 230 ft^3/s Canal Alternative

Main features of the 230 ft^3/s Canal Alternative would include the pumping plant, canal, distribution and drainage facilities for canalside irrigation (including private irrigation and Rocky Boy's Reservation) and drainage facilities for lands irrigated under junior water rights.

Pumping Plant.--An infiltration gallery pumping plant with 230-ft^3/s capacity would be located 1/2 mile upstream of Boggs Island on the Missouri River. A 66-inch diameter discharge line 1,500 feet long would convey water from the pumping plant to a surge tank on top of the bluff, a static lift of 200 feet. A system to backflush sediment from the gallery would be included in the design.

The infiltration gallery would consist of a plot (660 feet by 310 feet) excavated from the bottom of the river and filled with gravel. Well screens would be laid horizontally in the gravel bed. Water would be drawn from the river bottom and filtered through the gravel, eliminating a primary concern of the residents in the canal area, the transport of weed seeds. This design would also have minimal affect on the fishery after construction, as the approch velocity at the river bottom would be less than .02 ft/s.

The pumping plant would be located in a segment of the Missouri River designated as part of the National Wild and Scenic River System (P.L. 94-486, October 12, 1976). This designation preserves the river in its free-flowing condition. In accordance with this act, the segment of the river from Fort Benton to Coal Bank Landing is managed from bank-to-bank by the Bureau of Land Management and Montana Department of Fish, Wildlife and Parks (see Figure 4.3). Coal Banks Landing is a favorite recreational boat launching site. Downstream of Coal Banks Landing, the river is managed from rim-to-rim. This means upstream of Coal Banks Landing there can be no visual intrusions from bank-to-bank of the river. Downstream of Coal Banks Landing, visual intrusions are even more strict--no visual intrusions from rim-to-rim of the bluffs.

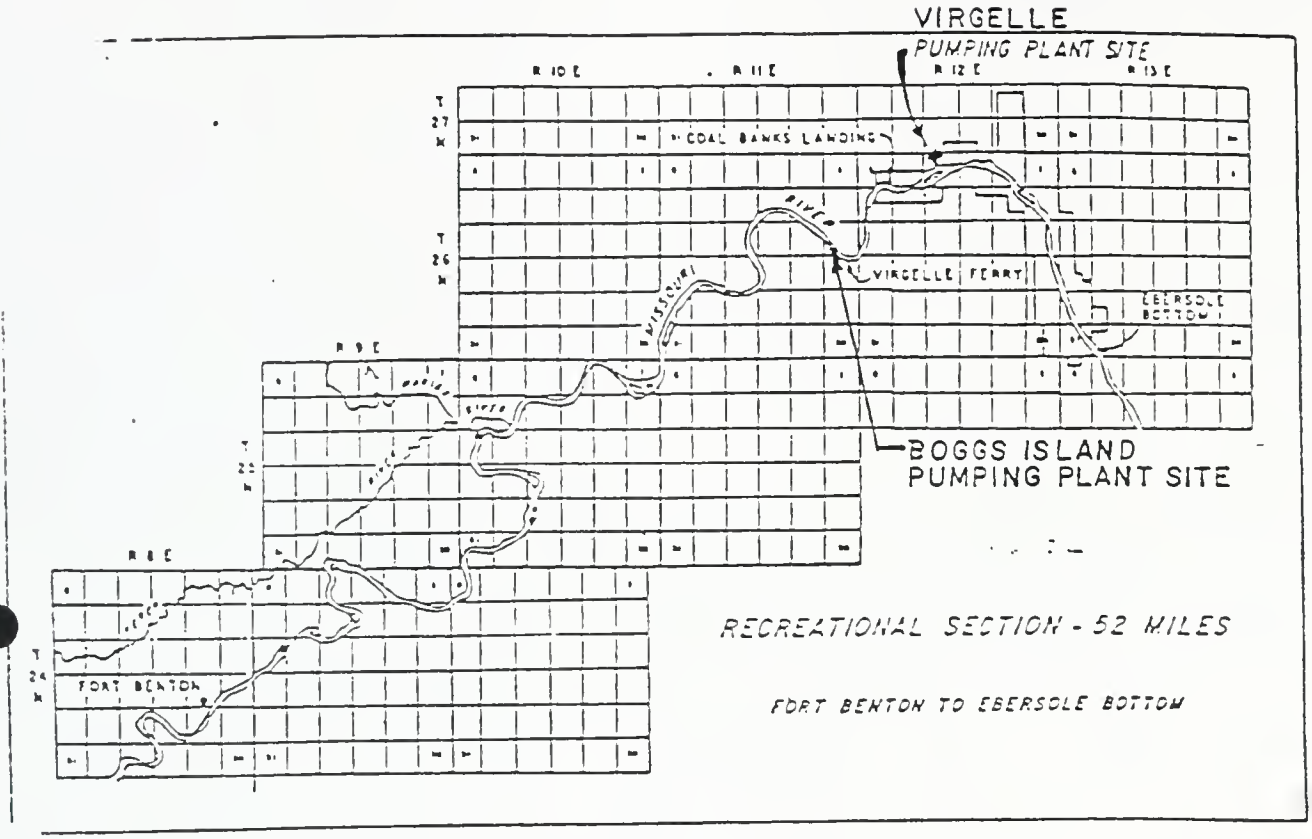

VIRGELLE
PUMPING PLANT SITE
R 10 E
R 11 E
R 12 E
R 13 E
T 27 N
T 26 N
T 25 N
T 24 N
COAL BANKS LANDING
MISSOURI RIVER
VIRGELLE FERRY
EBERSOLE BOTTOM
BOGGS ISLAND
PUMPING PLANT SITE
R 9 E
R 8 E
FORT BENTON
RECREATIONAL SECTION - 52 MILES
FORT BENTON TO EBERSOLE BOTTOM

FIGURE 4.3

The proposed site is (upstream of Boggs Island) in the section managed bank-to-bank. The plant would be 80 feet from the north bank of the Missouri River behind an existing railroad embankment. Except for the electrical transmission lines and the surge tank on the bluff behind the plant, facilities would be screened from viewers on the river. This location would also reduce noise audible to recreationists.

Reclamation considered four possible pumping plant sites and three designs before deciding on the infiltration gallery design at the site near Boggs Island. The infiltration gallery design was selected because it would prevent the transport of weed seeds, have minimal fish loss, minimal visual intrusion, and lower O&M cost. The Boggs Island site was selected to avoid impacts to recreation and the fishery.

An open forebay pumping plant design was not chosen at the Virgelle sites because it would have violated visual standards in the area of the river most favored by floaters. The design might have been acceptable at either of the Boggs Island sites where visual standards are less restrictive, except the open forebay plant could transport weed seeds and would cause a loss of fish.

A submerged intake pumping plant design, drawing water directly from the river was also considered. The intake system would consist of multiple surface water intake screens placed 2 feet above the river bottom. The screens would be cylindrical in shape with a 2-foot diameter. The plant would be built mostly below ground; only the tops of the electric motors the switchyard and electrical transmission lines would have been visible from the river. Unfortunately, this design would have the highest O&M cost due to the annual precautionary removal of intake screens to prevent damage from ice jams that frequent the Missouri in winter. The screens also could prevent the transport of weed seeds.

Canal.--Four canal routes were evaluated in the Virgelle-Milk Alternative (see "Canal Routes and Plans Dropped from Consideration" at the end of this chapter). The proposed route would follow the existing Burlington Northern Railroad line right-of-way (ROW) most of the way from the Missouri to the Milk (Figure 4.4). This route was selected because it

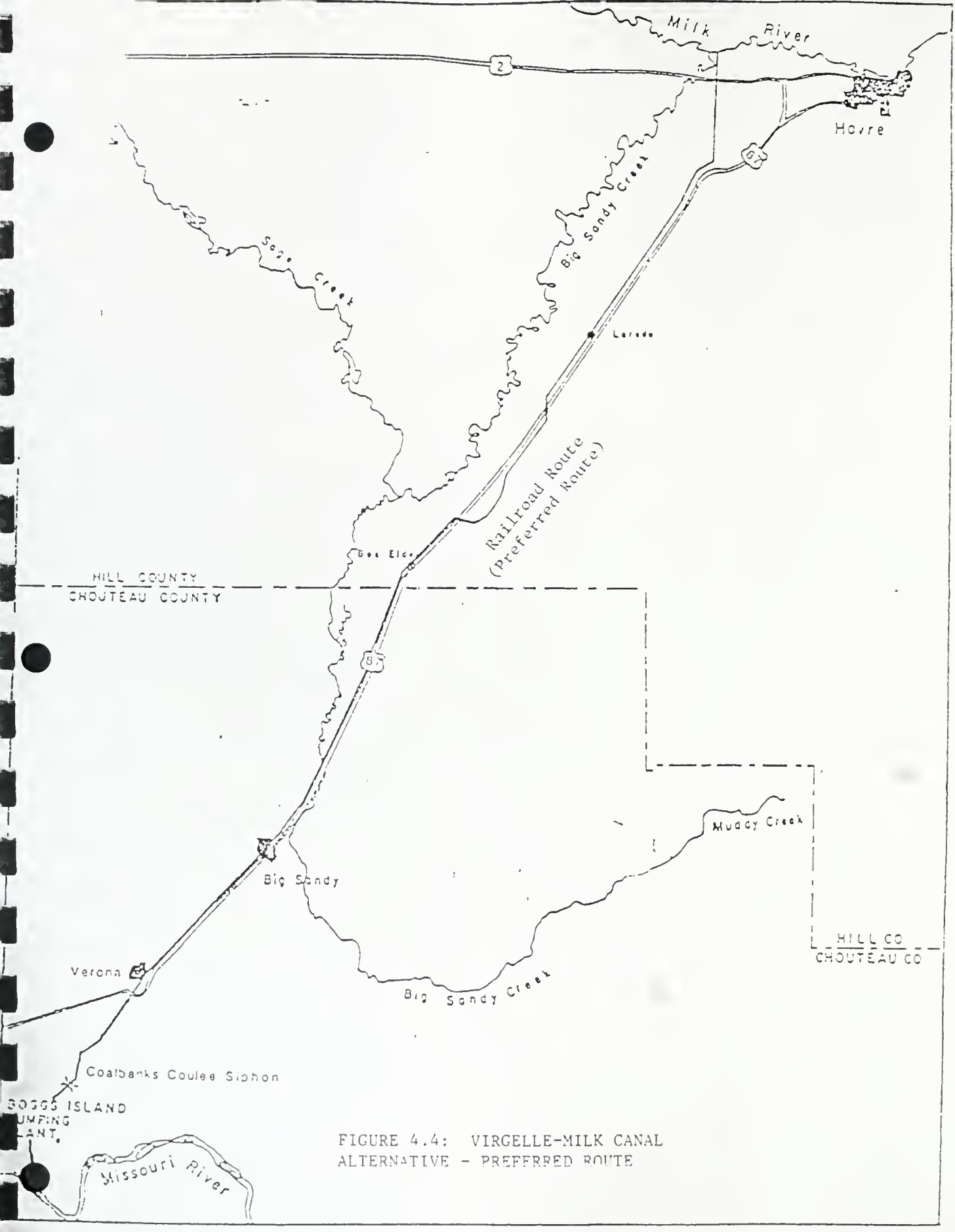


FIGURE 4.4: VIRGELLE-MILK CANAL ALTERNATIVE - PREFERRED ROUTE

would cause the least disruption to the local residents and would have the least impact to the environment.

The canal would be 46 miles long and require 5 siphons, along with 11 concrete drop structures. The canal would be about 12 feet wide at the bottom, 42 feet wide at the top, and 7-1/2 feet deep. A total of 35 canal crossings would need to be built for the canal route to provide access to local dryland farm operators. The canal's terminal drop structure into the Milk River would require 850 feet of 60-inch diameter pipe, with the water being emptied into an energy-dissipating stilling basin. About 500 feet of channel would convey the water to the river, 100 feet of which would be protected by riprap. The total drop was estimated at 70 feet. The potential for including a small powerplant at the drop will be evaluated in the Planning Report.

Electrical transmission facilities would probably be provided by a 69-kilovolt line from a substation at Big Sandy to the pumping plant (a distance of 16 miles). An auto transformer would be required at the pumping plant. The Hill County Electric Cooperative is presently interested in sharing in the cost of the substation and distribution line, but will probably begin construction of its own facilities in the next year or two.

One of the primary concerns of Big Sandy area residents is that a canal through the area would increase the seeps occurring in this dryland area. Three methods of controlling seepage from the canal were evaluated in the canal design:

1. No lining with toe drains installed as needed along both sides of the canal to collect seepage.

2. Membrane lining, with toe drains installed as needed in areas with high water tables (the toe drains would protect the lining during winter).

3. Compacted-earth lining with toe drains installed as needed in areas with high water table.

Of the three lining options, the membrane lining method was selected to ensure that seeped areas would not increase. No lining with toe drains was the least costly, the compacted-earth lining the most costly.

Canalside Irrigation Facilities.--About 6,600 irrigable acres would be irrigated along the Virgelle-Milk Canal (3,300 acres on the Rocky Boy's Reservation and 3,245 acres on private land). Isolated areas and fields smaller than 20 acres were not considered economical to serve and typically were not included in the project. It was assumed the land would be sprinkler-irrigated because most irrigable land is located above the canal elevation and is widely scattered.

The lateral system for canalside irrigation was sized according to a peak delivery rate of .021 ft^3/s per acre (48 acres per ft^3/s), derived by using a 2-inch/foot waterholding capacity of the soil and a 4-foot root zone. Sprinklers would operate 22 hours daily, with farm efficiency assumed to be 75 percent. The average annual CIR for the project area was determined to be 14.83 inches of water.

Estimated distribution and drainage system costs are as follows:

Summary of Costs

Feature	Rocky Boy's Reservation Construction Costs (3,300 acres)	Private Irrigation Construction Cost (3,245 acres)
Pipe Laterals, Pumps and Electric Transmission	$4,800,000 1/	$3,700,000 1/
Drainage	3,400,000 2/	3,900,000 2/
Total	$8,200,000	$7,600,000

1/ Includes 10 percent unlisted items, 25 percent contingencies, 30 percent indirects.
2/ Based on $51,000/mile ($31,944/mile for labor and materials, 10 percent unlisted items, 15 percent contingencies, and 25 percent indirects.)

Drain spacing requirements were determined for individual parcels of land. About 136.5 miles of drains would be needed (66.5 miles on the Rocky Boy's Reservation and 70 miles on private land). Reclamation experience on other projects show these drains would be needed from 5 to 30 years after the beginning of irrigation.

Drainage Facilities for Land Irrigated Under a Junior Water Right.--Drain spacing requirements were also determined for all parcels irrigated outside of the irrigation districts in the Milk River Basin. About 540 miles of drains would be required to maintain irrigation on the 25,000 acres of lands irrigation under junior water rights. Based on Reclamation experience, these drains would be installed over the next 40 years as needed.

Mitigation.--The U.S. Fish and Wildlife Service (USFWS) estimated 288 acres of native rangeland would be affected by construction of the Virgelle-Milk Canal. To mitigate loss of this habitat, about 362 acres of cropland would be reseeded within the rights-of-way (ROW) to create new rangeland. Mitigation for canal impacts would therefore be accomplished within the ROW. Since these costs are included in canal construction, there is no separable cost for mitigation. (See coordination with USFWS in Chapter 6 for details.)

The proposed irrigation of canalside lands (including Rocky Boy's Reservation) is estimated to cause the loss of 1,315 acres of native range. Recommendations to manage part of the Lonesome Lake area for mitigation have been developed. Lonesome Lake, about 5 miles northwest of the town of Big Sandy, is presently grazed under lease from BLM. As the Federal Government owns 14,596 acres around Lonesome Lake, no land need be acquired. Management costs have not yet been determined but are assumed to be relatively minor compared to other project costs.

Effects of 230 ft^3/s Canal Alternative

Water Supply.--Phase 2 was assumed to be in place prior to construction of the Virgelle-Milk Canal. The Milk River Project Irrigation districts

and contract pumpers should have an adequate water supply after Phase 2 is implemented. Enforcement of water rights in the basin will improve the districts water supply even more (see Table 4.1). Data from measuring devices installed as part of Phase 2 will be used to check the projected water savings.

The Virgelle-Milk 230 ft^3/s Canal was sized to provide water for the remaining needs in the basin:

Landowners with junior water rights
Fort Belknap Reservation (Gros Ventre-Assiniboine Tribes)
Municipalities
Bowdoin National Wildlife Refuge
BLM stock ponds (on tributaries)
Canalside landowners (Chippewa Cree Tribe on Rocky Boy's Indian Reservation and private irrigation)

A 230-ft^3/s canal could provide a maximum of 14,100 acre-feet per month. The landowners with junior water rights, Gros Ventre-Assiniboine Tribes, and canalside landowners would receive a full water supply, as defined by Reclamation guidelines. The guidelines state the water shortage must not exceed 50 percent in any 1 year or 100 percent in any 10-year period (see Table 4.3).

Table 4.3
DEMAND AND SHORTAGES AFTER PHASE 3 IS IMPLEMENTED

	Average Annual Demand (acre-feet)	Average Annual Water Shortage (%)	Maximum Water Shortage (1984) (%)	10-Year Total % Shortage
Districts and Contract Pumpers 1/	299,600	3	13	68
Landowners with Junior Water Rights	44,400	4	50	92
Fort Belknap Reservation Tribes	56,300	3	50	92
Canalside	10,300	1	50	92

1/ District and contract pumpers are not provided water under Phase 3. Their shortages are reduced to within Reclamation shortage guidelines through implementation of Phases 1 and 2.

The average monthly delivery would be divided among the users as follows during the 6-month irrigation season:

Water User	Average Delivery, Virgelle-Milk 230 ft^3/s Canal (1,000 acre-feet) April 1/	May	June	July	Aug	Sept	Oct 1/	Average Annual	% of Total
Fort Belknap Reservation	0.0	0.0	0.3	0.9	2.3	0.3	0.0	3.9	8
Landowners with Junior Water Right	0.1	0.6	0.9	4.2	1.2	0.3	0.1	7.3	15
Canalside Landowners	0.0	1.3	3.2	3.7	3.1	1.0	0.2	12.3	26
BLM	2.7	4.8	0.0	0.0	0.0	0.0	0.0	7.5	16
Lake Bowdoin	4.0	3.0	2.7	0.0	0.0	6.1	0.0	15.7	34
Municipalities				0.2	0.2			0.4	1
Total	6.8	9.7	7.1	9.0	6.8	7.7	0.2	47.1	100

1/ Pumping plant only operates half of month.

During drought years the diversions would be:

Water User	April	May	June	July	Aug	Sept	Oct	Average Annual	% of Total
	(1,000 acre-feet)								
Fort Belknap Reservation	0.0	0.1	2.4	2.5	4.7	0.3	0.0	10.0	15
Landowners with Junior Water Rights	0.6	4.2	8.0	8.3	4.2	0.1	0.0	25.4	37
Canalside Land	0.0	2.0	3.3	3.3	2.6	0.5	0.0	11.7	17
Lake Bowdoin	4.0	2.9	0.0	0.0	0.0	6.1	0.0	13.0	19
BLM	2.2	4.9	0.0	0.0	0.4	0.0	0.0	7.5	11
Municipalities					0.4			0.4	1
Total	6.8	14.1	13.7	14.1	12.3	7.0	0.0	68.0	100

Environmental Effects.--

Fish and Wildlife.--

The pumping plant (with a capacity of 230 ft^3/s) would annual withdraw up to 68,000 acre-feet of water from the Missouri River. The intake would be an infiltration gallery that, once in place, would have no significant effect on aquatic species. Construction would cause a temporary disturbance to the river bottom and some disturbance to the water column, such as increased turbidity. Standard construction safeguards and the proper timing of construction activities would minimize these effects.

Pumping plant electrical facilities would be built incorporating design consideration that would minimize the possibility of electrocuting raptors.

Canal construction would necessitate the crossing of 11.9 miles of native range, equal to 288 acres. By seeding agricultural land that would be within the railroad route ROW, 362 acres of "new" rangeland would be created. Mitigation for habitat lost to canal construction would be accomplished within the ROW required for the canal.

Irrigation of canalside land would cause the loss of 1,315 acres of native rangeland. Farmers breaking out new land will need to consult with SCS and develop a farm plan by 1990 or risk losing crop subsidy payments. The crop rotation proposed in the farm budgets should be acceptable under the "sod buster" provisions of the Food Security Act. It has been proposed that the managment of part of the Lonesome Lake area would provide compensation for this loss. As most of this area is in Federal ownership, no land acquisition would be required. Therefore, the only costs would be those associated with managing the grassland areas involved.

The Preferred Plan would provide up to 16,000 acre-feet of water to the Bowdoin National Wildlife Refuge. Some of this water delivery would have to be made before and after the normal irrigation season in April, May and September. The Fish and Wildlife Service will accept this type of delivery.

This water would freshen refuge pools, and restore waterfowl production to normal levels (see "Problems and Needs" Chapter).

Endangered species in the area include peregrine falcon, black-footed ferret and bald eagle. The piping plover, known to nest along the shoreline of Nelson Reservoir, is listed as threatened. These species will not be affected by the Preferred Plan.

Water Quantity

The recommended instream flow requirements for the Missouri River at the Virgelle gage are:

Use	Recommended Streamflow	Time Period
Paddlefish	14,000 ft^3/s	May 19 - July 5
Side Channels	5,400 ft^3/s	June 1 - August 31
Riffle Areas	4,305 ft^3/s	Yearlong
Goose Nesting	5,571 ft^3/s	March 15 - June 1
Recreation	7,470 ft^3/s	May 15 - July 15
Recreation	5,150 ft^3/s	July 15 - November 15
Channel Stability	22,600 ft^3/s	16 days between March 15 and July 15

Combining the above requirements are allowing for overlapping time periods yields the following average monthly flow requirement:

(Units are ft^3/s)

April	May	June	July	August	September	October
5,571	9,274	14,000	7,455	5,400	5,150	5,150

The channel stability requirement was not included in the average monthly requirements because it is only needed for a relatively short time and its time period is highly variable over a 4-month period.

Impacts to the capabilities of the Missouri River to meet the instream flow requirements due to Virgelle Canal diversions for the historic period of 1936 through 1985 are listed in Table 4.4. The preferred plan would be to release water from Lake Elwell (Tiber Dam) to replace the water diverted for transport to the Milk River. Lake Elwell was designed to provide 228,700 acre-feet/year firm yield to the Milk River Project. At present, none of that water is being used. Since the maximum yearly impact to the instream flow requirements is 73,252 acre-feet, Lake Elwell should have sufficient water to compensate.

Table 4.4 - Impacts to Missouri River Instream Flow Requirements Due to Virgelle Canal Diversion for the Historic Period of 1936 through 1985

(ft^3/s)

	April	May	June	July	August	September	October
Maximum	114	203	230	229	229	230	62
Avg.	10	14	63	58	59	64	2
10%	67	83	230	229	229	166	7
30%	0	0	148	60	59	121	0
50%	0	0	0	0	0	0	0

Note: Percentage is fraction of time period that impacts will be equal to or greater than the specified value.

Water Quality. - Representative sites of major land bodies in the Milk River, Big Sandy Creek and Rocky Boy's Reservation area were sampled to a depth of 10 feet. Samples were collected from major soil horizons, with a 6-inch minimum sample zone. The samples were analyzed in a laboratory to determine if 25 trace constituents/metallic elements were present in detectable concentrations. Objectives of this initial screening were to identify trends in data correlation between various elements and soil types, and to locate potential problem areas needing further analysis. After reviewing results of the analyses, selected sites were resampled because certain elemental concentrations exceeded expected concentrations of northern plains soils. The resampling is intended to verify the presence of the high trace element concentrations in the soil. Results of the second sampling will be discussed in the Planning Report/Environmental Statement.

Five surface soil sites representative of diverse conditions were sampled for pesticides. The sites included dryland, irrigated, return flow surface drain and wetland (Bowdoin National Wildlife Refuge) areas. The pesticide analyses were an organic scan for the farm chemicals known to be in common use in the area. Samples were collected during three individual sampling periods (spring, summer, and fall) in order to ensure detection of the compounds during peirods of application, plant uptake and runoff from irrigation and storm events. Laboratory analyses indicated all pesticide concentrations in surface soil were either insignificant or below detection.

The effect of importing water on the temperature of Milk River will be assessed in the environmental statement. The effect of return flows on Big Sandy Creek from canalside irrigation will also be assessed.

Cultural Resources. - A Class 3 cultural resource inventory was conducted by archeological consultants. At least 14 prehistoric and historic sites, of which three were recommended as potentially eligible or eligible for listing on the National Register of Historic Places, will be affected by the canal route. Two of these are in a direct line with the intake of the river, within the first mile. The Great Northern (GN) Railroad, portions of which were previously recorded as a historic site

(24CH585), has been found eligible by the Montana State Historic Preservation Office. That site and number, also given number 24HL869 for the portion in Hill County, applies to the railroad and associated features, which have been designated a National Register eligible historic District. Other potentially eligible sites include prehistoric stone circles with rock cairns, and cultural material scatters.

The proximity of the canal route to the railroad will result in visual effects to the eligible district as well as physical effects wherever it crosses the railbed.

Social Effects. - Social effects of project alternatives were evaluated using the following social factors:

1. Farms crossed by canal.
2. Concerns about canal seepage and weed spread.
3. Employment.
4. Population change - during construction and resulting from project.
5. Income - during construction and resulting from project.
6. Housing during construction.
7. Project costs.
8. Public facilities and services during construction.
9. Indian acreage irrigated by plan.

A summary matrix of social effects is provided in the plan selection chapter, along with a table summarizing the results of a Multi-Attribute Tradeoff System (MATS) analysis made on five principal factors.

Canal Impacts. - Several social concerns revolve around the number of farms severed by the canal, canal seepage, and the spread of weeds. The railroad route was suggested by people in the project areas as the route that would disrupt the fewest farming operations. The route would entail the crossing of 19 additional farms over and above those already crossed by the railroad. A total of 35 bridges would be built at existing railroad or natural crossing sites to mitigate the potential long-term

disruption. Of course, there would be a certain amount of inevitable inconvenience and disruption during the construction period.

The canal will be lined with plastic membrane lining. Seepage from the canal will be so insignificant that it will not be detectable when superimposed on the natural groundwater. Where groundwater is naturally above the canal grade, toe drains will be used to lower it enough to prevent damage to the lining when the canal is not in use.

Potential transfer of weed seeds from the Missouri River and how weeds would be controlled along the canal right-of-way are prime concerns. Reclamation is examining an infiltration gallery pumping plant intake for the project which would effectively eliminate the transport of weed seeds. A number of proven techniques could be utilized to control weeds along the canal, including spraying after earthwork is done, replanting the right-of-way with native grasses, and periodically spraying and mowing grass waterways.

Population. - Population changes due to the project would accrue only during the 2-year construction period. The total population increase is estimated to peak at about 290 people. This projection is based on Bureau of Reclamation guidelines regarding average employment levels per construction expenditures and related levels of population influx. Project construction would take place in Hill and Choteau Counties. There are several communities in the area which could absorb the increase, including Great Falls, Havre, Fort Benton, Chinook, and Big Sandy. It is assumed that residual agricultural jobs created by the project would be absorbed by the unemployed and underemployed in the area; thereby there would be no permanent population increase.

Employment and Income. - Direct onsite employment would peak at about 180 jobs, of which about 70 would be available to Fort Belknap and Rocky Boy's Reservation tribal members. Annual adjusted direct earnings (earnings less welfare losses) during the construction period would be about $6.8 million. It is estimated that about $2.7 million of these earnings would accrue to tribal employees.

The average annual increased agricultural income (both direct and indirect) resulting from the project would be about $8.2 million. It is estimated that about $2.2 million of this income would accrue to tribal members.

Average annual agricultural employment would increase by about 45 full-time jobs. About 30 percent of these jobs would be on tribal lands.

Housing. - It is estimated that about 60 additional housing units will be required during the construction period. This assumes that about 50 percent of the imported labor will bring temporary housing with them. This assumption is supported by recent studies which indicate substantial use of such housing by construction workers. As noted above, there are several communities which could absorb the additional demand without undue stress. Most counties in the area have vacancy rates approaching 10 percent as of the 1980 census, and it can be assumed that current rates are at least as high as of this writing, due to the continued depressed state of these rural economies. No additional housing needs are anticipated following the construction period.

Facilities and Services. - The population increase would not create an undue burden on most existing facilities and services. However, the area is typical of rural areas in this region, in which provision of social and medical services is difficult due to distances traveled and restricted social and cultural opportunities. Therefore, increased pressures on medical and dental facilities could be anticipated during the 2-year period. School systems in the area should have capacity sufficient to accommodate the expected peak of about 100 additional students, due to long-term population losses in most areas of the region.

Project Costs. - Construction and operation of facilities under the Preferred Plan would, of course, impose increased costs upon area irrigators. Total annual equivalent economic costs are estimated at about $6.4 million, with about $1.5 million of this amount accruing to the Rocky Boy's and Fort Belknap Reservations. However, the reservation capital costs would be deferred under the Leavitt Act of 1932, as long as the land remains in Indian ownership.

Indian Lands. - The Preferred Plan includes the irrigation of 9,850 dryland equivalent acres on the Fort Belknap Reservation and 3,300 acres on the Rocky Boy's Reservation.

Costs of 230 ft^3/s Canal Alternative

Construction Costs. - The January 1987 costs for the Virgelle-Milk 230-ft^3/s canal are shown on Table 4.5. The total of $87,000,000 includes $44,000,000 for the pumping plant and canal, $16,000,000 for distribution and drainage systems for canalside land, and $28,000,000 for drainage facilities for land irrigated with junior water rights. Construction of the drains will be deferred until needed.

Operation, Maintenance and Replacement Costs. - The annual OM&R for a 230-ft^3/s pumping plant at Boggs Island and 46 miles of canal to the Milk River is estimated to be $130,000.

Project energy requirements include 14,160,000 kwh for pumping an average of 47,100 acre-feet per year from the Missouri River and 2,730,000 kwh for providing 10 feet of head at the pivot for canalside lands. This energy would be provided at Pick-Sloan Missouri Basin rate of 2½-mills/kwh.

In addition, the operators would pay for energy to provide 45 psi to each sprinkler at a rate of 51 mills/kwh (the average rate charged by Montana electric cooperatives).

The OM&R costs for the canalside irrigation distribution systems were estimated on per-acre costs based on similar OM&R studies.

Item	Annual Cost
Canal and Pumping Plant	$ 130,000
Energy (main pumping plant)	35,000 1/
Subtotal	$ 165,000
Rocky Boy's and Canalside	
Irrigation System	$ 138,000
Energy (Distribution System)	7,000 2/
Subtotal	145,000
Total (Rounded)	$ 310,000

1/ $\frac{47,100 \text{ acre-feet} \times 220 \text{ foot TDH}}{.75 \text{ efficiency}} \times 1.025 = 14,160,000$ kwh at $2\frac{1}{2}$-mills

2/ 2,730,000 kwh to provide 10 feet of head at pivot at $2\frac{1}{2}$-mills

Table 4.4

CONSTRUCTION COST FOR VIRGELLE-MILK 230 ft^3/s CANAL ALTERNATIVE

(Preferred Alternative)

(January 1987 Prices)

Pumping Plant	$ 6,066,308
Cofferdam	274,024
Discharge Line and Surge Protection	1,406,015
Canal	22,870,854
Terminal Drop	625,129
Siphons	3,419,000
Drop Structures	695,500
Toe Drains	715,000
Canal Crossings	1,787,500
Transmission Facilities	1,929,957
Cross Drainage	2,225,366
Mobilization	2,000,000
Subtotal (Rounded)	$44,000,000 1/
Canalside Distribution System 4/	8,500,000
Drainage Systems	
- Canalside 2/ 4/	7,300,000
- Landowners with Basin Junior Water Rights 3/	28,000,000
Total (Rounded)	$88,000,000

1/ Includes 10 percent unlisted items, 25 percent contingencies, 30 percent indirects.

2/ To be deferred 5-30 years.

3/ To be deferred 1-40 years.

4/ Includes private irrigators and Rocky Boy's Indian Reservation.

Economic Analysis of 230 ft^3/s Canal Alternative

The economic analysis for the 230-ft^3/s Virgelle-Milk Canal Alternative is displayed in Table 4.6. More detailed explantion of the derivation of benefits is presented in Attachment 2.

Construction costs include the canal, pumping plant and distribution system for canalside irrigation based on January 1987 costs. The total investment costs were converted to an annual equivalent based on 8-5/8 percent interest and a 100-year period of analysis.

Drainage needs were evaluated for canalside acres and lands irrigated under junior water rights. With good management and properly designed onfarm irrigation systems, it is expected that drainage requirements for canalside acres can be deferred 5 years and then be installed over the following 25-35 years. Drainage installations on lands with junior water rights will begin the first year appropriation areas are available for the project and continue over the next 40 years.

Opportunity cost of power is the marginal cost of project pumping and was computed as the variable cost of replacing power withdrawn from summer users of the Pick-Sloan Missouri Basin Program. The economic cost of power is 22.2 mills per kwh.

Interst during construction was calculated based on 8-5/8 percent compounded annually for a 2-year construction period.

The annual irrigation benefit for a full water supply is estimated to be $142 for each acre (see Appendix 2 for details). The canalside acres are currently dryland. Therefore, the benefit is $469,000/year for irrigating 3,300 acres on Rocky Boy's Reservation (3,300 acres x $142/acre) and $461,000/year for irrigating 3,245 acres of private canalside lands (3,245 acres x $142/acre).

This same benefit value per acre was claimed for the 25,000 acres irrigated under junior water rights. These lands are presently irrigated; however, when water right adjudication is enforced, these landowners

Table 4.5
BENEFIT-COST ANALYSIS
VIRGELLE-MILK 230 ft^3/s CANAL ALTERNATIVE
(Preferred Plan)

(Annual Equivalent Values)

Costs	
Construction 1/	$4,529,000
Drainage 2/	844,000
Interest During Construction(IDC) 3/	399,000
Economic Cost of Energy 4/	333,000
OM&R 5/	310,000
TOTAL Costs	$6,415,000
Benefits	
Irrigation 6/	$5,879,000
Fish and Wildlife (Lake Bowdoin) 7/	120,000
Bureau of Land Management Stockponds 8/	70,000
Unemployment 9/	159,000
Municipal and Industrial	37,000
TOTAL Benefits	$6,265,000
Net Benefits	$ 150,000
Benefit-Cost Ratio	.98

1/ Construction

Canal and pumping plant $44,000,000 x .08627) 10/	$3,796,000
Canalside Dist. ($3,700,000 x .08627)	319,000
Rocky Boy's Dist. ($4,800,000 x .08627)	414,000
	$4,529,000

2/ Drainage

Canalside Drainage ($3,900,000 divided by 25 years x 10.12867 11/ x .66122 11/ x .08627)	$ 90,000
Rocky Boy's Drainage ($3,400,000 divided by 25 years x 10.12867 11/ x .66122 11/ x .08627)	79,000
Pumpers ($28,000,000 divided by 40 years x 11.17051 11/ x .08627)	675,000
	$ 844,000

3/ IDC ($52,500,000 construction cost x .088 x .08627)	$ 399,000
4/ Energy (16,890,000 kwh x $.0197/kwh)	333,000
5/ OM&R	
Canal and Pumping Plant	130,000
Canalside Distribution	68,000
Rocky Boy's Distribution	70,000
Energy (18,066,000 kwh x $.0025/kwh)	42,000
	$ 310,000

6/ Irrigation

Rocky Boy's Reservation (3,300 acres x $142/acre)	$ 469,000
Private Canalside (3,245 acrs x $142/acre)	461,000
Fort Belknap (9,850 acres x $142/acre)	1,399,000
Junior Water Rights (25,000 acres x $142/acre)	3,550,000
	$5,879,000

7/ Fish and Wildlife

OM&R (12,700 acre-feet x $3.72/acre-foot)	$ 47,000
Energy (12,700 acre-feet x 220' TDH) x	73,000
.75 efficiency	120,000
1.025 x $.0197)	

8/ BLM

OM&R (75.00 acre-feet x 3.72 acre-feet)	26,000
Energy (7500 ac-ft x 220 ac-ft TDH) x 1.025 x $.0197	44,000
.75 efficiency	$70,000

9/ Unemployment (52.5 construction cost in $1,000 x $3,023/$1,000 159,000

10/ .08627 is annualization factor at 8-5/8 percent

11/ Deferral factors for drainage

would have shortages greater than 10 percent in 6 out of 10 years. In 1 out of 10 years, shortages would be over 50 percent. In extremely dry years no water could be provided to landowners with junior rights; the water supply would be only adequate for senior rights. Without an additional water supply to the basin, these lands would revert to dryland.

Even with their reserved water right, the Gros Ventre-Assiniboine Tribes would require a supplemental supply from the canal to provide a full water supply to 24,425 acres. To determine the benefit for providing this supplemental water, a dryland equivalent acreage was used. (The dryland equivalent is the number of acres that would have to be taken out of production for the remaining acres to have a full water supply). About 9,850 acres would have to be taken out of production to provide a full water supply to the remaining 14,575 acres. The benefit for Fort Belknap Reservation is $1,399,000 (9,850 acres x $142).

The Fort Belknap and Rocky Boy's Indian Reservations have been designated as "substantial and persistent" unemployment areas by the U.S. Department of Commerce. The unemployment benefits were estimated based on a 75 percent unemployment rate with 50 percent of the unskilled and 30 percent of the skilled onsite construction labor being Indian.

The only community indicating interest in M&I water is Chinook. There is no alternative source for additional water for the community; therefore, Chinook requested 400 acre-feet of water from the canal. The benefits were determined by the use of facilities method and amount to $37,000 annually.

Water for both Lake Bowdoin and BLM stockponds would be provided without separable canal capacity. Water for Lake Bowdoin would be provided before and after the irrigation season. Benefits for Fish and Wildlife and BLM were based on the incremental energy and OM&R costs.

Total annual equivalent costs are $6,415,000. The benefits associated with these costs are $6,265,000; for a -$150,000 in net annual benefits.

Financial Analysis of 230 ft^3/s Canal Alternative

The payment capacity of the land to be provided a water supply was estimated from typical farm budget analysis with and without the project. (See Attachment 2 for details). The computed payment capacity is $19.63 per acre.

This payment capacity is the estimated annual amount the irrigator could pay for repayment of project costs and annual OM&R. The costs of the project and OM&R to be repaid by each water user group were allocated based on average use of facilities. For example, during an average year, 8 percent (3,900 acre-feet) of the total diversion (47,100 acre-feet) is pumped from the Missouri River for use on the Fort Belknap Reservation. The use of facilities is as follows:

	Average Annual Diversion (acre-feet)
Fort Belknap Reservation	3,900
Landowners with Junior Water Rights	7,300
Canalside (private)	6,150
Canalside (Rocky Boy's Reservation)	6,150
BLM	7,500
Bowdoin National Wildlife Refuge	15,700
Town of Chinook	400
Total	47,100

Annual OM&R charges (including energy) for the canal and pumping plant were allocated as shown below and on Table 4.7, based on use of facilities. All water users would pay their share of OM&R.

	Annual OM&R	
	Total	Per Acre
Fort Belknap Reservation	$ 14,300	$ 1.45
Landowners with Junior Water Rights	26,700	1.07
Canalside Private	22,500	6.93
Canalside - Rocky Boy's	22,500	6.82
BLM stockwater ponds	27,300	--
Bowdoin National Wildlife Refuge	57,300	--
Town of Chinook	1,400	--
Total	$172,000	

The total allocated costs are as shown below. Costs allocated to Bowdoin National Wildlife Refuge, BLM stockwater ponds, and municipal use is nonreimbursable; there is no separable canal capacity for these functions. The amount to be repaid by the Fort Belknap and Rocky Boy's Tribes would be indefinitely deferred under the Leavitt Act of July 1, 1932, as long as the land remains in Indian ownership. These entities would pay their share of OM&R energy costs.

Total Allocated Costs for 230 ft^3/s Canal Alternative

	Canal and Pumping Plant	Distribution System	Drainage System	Total
Fort Belknap Reservation	3,643,000 1/	--------	------	3,643,000
Landowners with Junior Water Rights	6,820,000 2/	--------	28,000,000	34,820,000
Private Canalside Landowners	5,745,000 3/	3,700,000	3,900,000	13,345,000
Rocky Boy's Reservation	5,745,000 3/	4,800,000	3,400,000	13,945,000
BLM Stockwater Ponds	7,006,000 4/	--------	------	7,006,000
Bowdoin National Wildlife Refuge	14,667,000 5/	--------	------	14,667,000
M&I	384,000 6/	--------	------	384,000
Total	44,000,000	8,500,000	35,300,000	87,800,000

1/ 3,900/47,100 x $44,000,000
2/ 7,300/47,100 x $44,000,000
3/ 6,150/47,100 x $44,000,000
4/ 7,500/47,100 x $44,000,000
5/ 15,700/47,100 x $44,000,000
6/ 400/47,100 x $44,000,000

It was assumed drains would be funded through a sinking fund established as part of the repayment contract. Irrigators would pay into the fund annually and funds would be used to install drains as needed.

If the landowners with junior water rights repaid their share of the project costs at the $19.63 rate, they would repay the costs in 19 years. If the irrigators were authorized to repay the project costs for 40 years, their annual payment would be $11.55/acre ($6.82 for repayment of project costs, $1.07 for OM&R, and $3.66 for a sinking fund to install drains as needed). This is shown in the following tabulation and on Table 4.6.

Payment Capacity	$ 19.63
minus OM&R	1.07
minus sinking fund for drains	3.66
Total Available for Repayment	14.90

$6,820,000 allocated costs divided by 19 years = $ 372,000/25,000 acres
$6,820,000 allocated costs divided by 40 years = $ 170,500/25,000 acres
$ 6.82/acre

The costs for serving private canalside irrigators exceed the National Economic Development benefit for these acres. Therefore, according to Bureau criteria, these costs must be funded by a non-Federal entity (see Chapter 5 for details). The payment capacity of private canalside irrigators ($19.63/acre) is not adequate to meet their OM&R costs, but the unpaid balance of these costs will be assumed by the non-Federal entity. Also, this entity will pay the allocated canal pumping plant costs and drainage facilities costs. The following tabulation and Table 4.7 shows the derivation of the subsidy per acre required for these lands.

	Per Acre
Allocated Costs	$ 72.77
Drainage Facilities	3.24
OM&R	28.02
Total Charges	$104.03
Available for Repayment	19.63
Subsidy Required	84.40
Total Annual Subsidy	$273,900

Table 4.6
VIRGELLE-MILK 230 ft^3/s CANAL ALTERNATIVE
PAYMENT CAPACITY AND REIMBURSABLE COSTS
(40-Year Repayment Period)

	Payment Capacity $/Acre	OM&R $/Acre	Available for Repayment $/Acre	Reimbursable Costs (000's)	Water Charges $/Acre/40 Year
Fort Belknap Tribes	19.63	1.5 1/	18.18	3,643 1/	Deferred
Landowners with Junior Water Rights	19.63	1.07 1/	18.56	34,820 1/	11.55 4/
Canalside - Private	19.63	27.89 2/	- 8.26	13,345 1/	5/
Canalside - Rocky Boy's	19.63	28.03 3/	- 8.40	13,945 1/	Deferred

1/ Derivation shown on page 4-45

2/ Canal OM&R $ 6.93/acre
Dist. OM&R 20.96/acre
Total $27.89/acre

3/ Canal OM&R $ 6.82/acre
Dist. OM&r 21.21/acre
Total $28.03/acre

4/ Derivation shown on page 4-43

5/ The OM&R costs beyond the ability of the irrigators to pay and the distribution system cost will be paid by a non-Federal entity.

Virgelle-Milk 200-ft^3/s Canal Alternative

A 200-ft^3/s canal would serve all water users except the 3,300 acres irrigated by private canalside landowners. This alternative provides the maximum net benefit for the Federal investment and enhances the social well-being of the Gros Ventre-Assiniboine and Chippewa Cree Tribes (see Chapter 5 for details).

Feature of 200-ft^3/s Canal Alternative

The pumping plant and canal would be in the same location; the capacity would be reduced to 200 ft^3/s. Distribution and drainage systems for private canalside lands would not be constructed.

Mitigation

Native rangeland affected by canal construction would be mitigated by reseeding within the canal right-of-way to create new rangeland. To mitigate for loss of native rangeland on the Rocky Boy's Reservation, a portion of Lonesome Lake would be managed for wildlife.

The FWS, as part of the planning process, was asked to evaluate different canal routings, as opposed to sizes, for this document. Consequently, it is assumed that the impacts of constructing this size canal would be no worse than for the 230-ft^3/s canal as the planned ROW width is the same.

Effects of 200-ft^3/s Canal Alternative

Water Supply.--The 200-ft^3/s canal would provide the same water supply to the Milk River irrigators and Chippewa Cree Tribe as the 230-ft^3/s canal. Shortages to the Milk River irrigators would be the same as shown on Table 4.5. Private canalside irrigators would not be served.

Environmental Effects.--The environmental concerns connected with canalside irrigation would be avoided. Other environmental concerns would be the same as, or slightly reduced from, the Preferred Plan. (See, also, previous discussion under Mitigation.)

Social Effects.--The social effects discussed for the Preferred Plan would be similar for this plan. However, the construction costs of this alternative would be about 13 percent less than that of the Preferred Plan; therefore, impacts on employment, population, income, etc., during the construction period would decrease proportionately. Similarly, the total annual agricultural income resulting from the plan would be about 8 percent less than that of the Preferred Plan, with a commensurate reduction in general economic activity in the region. Social effects are summarized in Table 5.2, Comparison of Social Accounts, and in Table ___, which is a summary of the evaluation of principal social factors by use of the MATS Program.

Costs of Virgelle-Milk 200-ft^3/s Canal Alternative

The January 1987 costs for the 200-ft^3/s Canal Alternative is $77,200,000.

Pumping Plant and Canal	$ 41,000,000
Drainage Facilities for Landowners with Junior Water Rights 1/	28,000,000
Rocky Boy's Reservation (3,300 acres)	
Distribution System	4,800,000
Drainage Facilities 2/	3,400,000
	$ 77,200,000

1/ To be deferred 1-40 years.
2/ To be deferred 5-40 years.

Operation, Maintenance and Replacement (OM&R) Costs

The annual OM&R costs are estimated to be $126,000. In addition, the pumping plant would require an average of 12,860,000 kwh of energy per year at 2½-mills, or $32,000 (40,950 acre-feet x 314 kwh/acre-feet x 2.5 mills/ kwh).

Economic Analysis of 200-ft^3/s Canal Alternative

Derivation of the annual equivalent costs and benefits is shown and discussed under the 230-ft^3/s Canal Alternative. For the 200-ft^3/s Canal Alternative, the annual benefits ($5,780,000) would exceed the annual costs ($5,475,000), resulting in a benefit-cost ratio of 1.06 (see Table 4.7).

Table 4.7

BENEFIT-COST ANALYSIS
VIRGELLE-MILK 200-ft^3/s CANAL ALTERNATIVE

(Annual Equivalent Values)

Costs	
Construction 1/	$ 3,951,000
Drainage 2/	675,000
IDC 3/	348,000
Economic Cost of Energy 4/	271,000
OM&R 5/	230,000
Total Costs	$ 5,475,000
Benefits	
Irrigation 6/	$ 5,418,000
Fish and Wildlife 7/	117,000
BLM 8/	70,000
Unemployment 9/	138,000
Municipal and Industrial	37,000
Total Benefits	$ 5,780,000
Net Benefits	$ 305,000
Benefit-Cost Ratio	1.06

1/ Construction

Canal and Pumping Plant (41,000,000 x .08627 annualization factor)	$ 3,537,000
Rocky Boy's Dist. ($4,800,000 x .08627)	414,000
	$ 3,951,000

2/ Drainage

Pumpers ($28,000,000 divided by 40 years x 11.17051 10/ x .08627)	$ 675,000
Rocky Boy's ($3,400,000 divided by 25 years x 10.12867 10/ x .66122 10/ x .08627)	79,000
	$ 754,000

3/ IDC ($45,800,000 x .088 x .08627) $ 348,000

4/ Energy $\left(\frac{45{,}700 \text{ AF} \times 200' \text{ TDH} \times 1.025 \times \$.0197}{.75 \text{ efficiency}}\right)$ $ 271,000

5/ OM&R

Canal and Pumping Plant	$ 126,000
Energy $\frac{45{,}700 \text{ AF} \times 220' \text{ TDH} \times 1.025 \times \$.0025}{.75 \text{ efficiency}}$	34,000
Rocky Boy's Reservation Distribution System	70,000
	$ 230,000

Footnotes, continued

6/ Irrigation

Junior Water Rights (25,000 acres x $142/acre)	$ 3,550,000
Fort Belknap (9,850 acres x $142/acre)	1,399,000
Rocky Boy's Reservation (3,300 acres x $142/acre)	469,000
	$ 5,418,000

7/ Fish and Wildlife

OM&R (12,700 acre-feet x $3.45/acre-foot)	$ 44,000
Energy ($\frac{12,700 \text{ AF} \times 220' \text{ TDH} \times 1.025 \times \$.0197}{.75 \text{ efficiency}}$)	73,000

8/ BLM

OM&R (7,500 acre-feet x $3.45/acre-foot	$ 26,000
Energy ($\frac{7,500 \text{ AF} \times 220' \text{ TDH} \times 1.025 \times \$.0197}{.75 \text{ efficiency}}$)	44,000

9/ Unemployment (45.8 x $3,023) $ 138,000

10/ Deferral factors

Financial Analysis of 200-ft^3/s Canal Alternative

The payment capacity was developed as discussed in Attachment 2. The computed payment capacity is $19.63. An annual payment of $12.12 by the landowners with junior water rights would pay annual OM&R ($1.15), establish a sinking fund for drains ($3.66), and repay the reimbursable costs ($7.31) over a 40-year period (see Table 4.9). If the reimbursable costs were paid at a rate of $19.63 ($14.82) for repayment, $1.15 for OM&R and $3.66 for drainage) the repayment period would be 20 years. 1/

Repayment for land in Indian ownership would be indefinitely deferred under the Leavitt Act, as long as the land remains in Indian ownership.

Virgelle-Milk 175-ft^3/s Canal Alternative

Reclamation guidelines require that an alternative be formulated that maximizes the benefits to the nation. This is referred to as the National Economic Development (NED) Alternative. The Virgelle-Milk 175-ft^3/s Canal Alternative, which includes capacity to serve the Fort Belknap Tribes and the landowners with junior water rights, meets this criteria. (See Chapter 5 for more details.)

Features of 175-ft^3/s Canal Alternative

The pumping plant and canal were sized to serve only the landowners with junior water rights and the Gros Ventre-Assiniboine Tribes. The pumping plant location and canal route would be the same as the Preferred Plan. Mitigation costs would only include reseeding cropland within the canal right-of-way to create new rangeland.

1/ $7,308,900 allocated costs divided by [$14.82 x 25,000 acres = $370,500/year] = 20.

Table 4.8

VIRGELLE-MILK 200-ft^3/s CANAL ALTERNATIVE
PAYMENT CAPACITY AND REIMBURSABLE COSTS

	Payment Capacity ($/Acre)	OM&R ($/Acre)	Available for Repayment ($/Acre)	Reimbursable Costs Costs	Water Charges ($/Acre) (for 40 Years)
Landowners with Junior Water Rights	19.63	1.15 1/	18.48	35,309,000 7/	12.12 2/
Fort Belknap Reservation	19.63	1.57 3/	Deferred	3,905,000 4/	Deferred
Rocky Boy's Reservation	19.63	28.58 5/	Deferred	14,357,000 8/	Deferred

---

1/ OM&R - 7,300/40,950 x $162,000 divided by 25,000 acres = $ 1.15/acre

2/ Canal - 7,300/40,950 x $41,000,000 divided by 25,000 acres divided by 40 years = $ 7.31/acre
Drainage - $28,000,000 x .00327 (40 years, 8-5/8 percent sinking fund) = $ 3.66/acre
Canal OM&R $ 1.15/acre

3/ OM&R - 3,900/40,950 x $162,000 divided by 9,850 acres $ 1.57/acre

4/ Canal - 3,900/40,950 x $41,000,000

5/ OM&R
Canal - 6,150/40,950 x $162,000 divided by 3,300 acres = $ 7.37/acre
Dist. - $70,000 divided by 3,300 acres = $21.21/acre

6/ Costs
Canal - 6,150/40,950 divided by $41,000,000 = $ 6,158,000
Dist. = 4,800,000
$10,958,000

7/ Canal - 7,300/40,950 x $41,000,000 = $ 7,309,000
Drainage 28,000,000
$35,309,000

8/ Canal - 6,150/40,950 x $41,000,000 = $ 6,157,000
Drainage 3,400,000
Distribution 4,800,000
$14,357,000

Effects of 175-ft^3/s Canal Alternative

Water Supply.--The 175-ft^3/s canal would provide the same water supply as the 230-ft^3/s canal to the Milk River irrigators. Private canalside landowners and Chippewa-Cree Tribe would not receive a water supply.

Environmental Effects.--Environmental effects associated with the actual construction of the pumping plant and canal would be the same as the Preferred Plan. For example, impacts on historical sites, loss of wildlife habitat in canal right-of-way, etc., would not change based on utilizing the same ROW width. Impacts caused by irrigating private canalside lands and Rocky Boy's Reservation lands would be avoided.

As discussed under the 200-ft^3/s plan, canal routings, rather than capacities, were evaluated by the FWS. Consequently, no quantification on the differences of impacts between canal sizes is available, nor is it thought to be significant.

Social Concerns.--The social impacts for the 200-ft^3/s canal would be similar to those of the 230-ft^3/s canal. However, the construction costs of this alternative would be about 30 percent less than costs for the 230-ft^3/s canal; therefore, impacts on employment, population, income, etc., during the construction period would decrease proportionately. Similarly, total annual agricultural income resulting from the plan would be about 15 percent less than that of the 230-ft^3/s canal, with a commensurate reduction in general economic activity in the region. These social impacts are summarized in Table 5.2, Comparison of Social Accounts.

Costs of 175-ft^3/s Canal Alternative

Total construction costs for the 175-ft^3/s Canal Alternative would be $65,000,000. The costs for 175-ft^3/s canal and pumping plant is $37,000,000. The costs for drainage facilities for landowners with junior water rights is estimated as $28,000,000. The drains will be installed as needed over the next 40 years.

Annual OM&R costs are estimated to be $146,000 including 10,927,200 kwh of energy at 2½-mills, or $26,000.

Economic Analysis of 175-ft^3/s Canal

The annual equivalent costs and benefits were derived as discussed under the 230-ft^3/s Canal Alternative. As shown on Table 4.9, the annual benefits ($5,285,000) exceed the annual costs ($4,510,000) by $785,000 for a benefit-cost ratio of 1.17. This alternative results in the maximum net NED benefits and is referred to as the NED Alternative. (See Plan Selection for more detail.)

Financial Analysis of 175-ft^3/s Canal

The payment was developed as discussed in Attachment 2. The computed payment capacity for the landowners with junior water rights would be $19.63 (see Table 4.10). Deducting their OM&R of $1.23 per acre and $3.66 for drainage sinking fund leaves $14.74 available for repayment of the reimbursable project costs ($7,800,000). An annual payment of $195,000 ($7.80/acre) would repay the reimbursable costs over a 40-year period. If the junior water right landowners repaid the reimbursable costs at the $19.63 rate, the repayment period would be 22 years. 1/

Repayment for land in Indian ownership would be indefinitely deferred under the Leavitt Act, as long as the land remains in Indian ownership. Interest during construction for the irrigation function is nonreimbursable. Bureau of Land Management and U.S. Fish and Wildlife Service would pay a portion of the OM&R and energy cost - $25,000 and $43,000, respectively.

1/ [25,000 x (19.63 - 1.23 OM&R - 3.66 drainage sinking fund)] = $368,500/year. $7,800,000 reimbursable capital costs divided by $368,500 = 22.

Table 4.9

BENEFIT-COST ANALYSIS
VIRGELLE-MILK RIVER 175-ft^3/s CANAL ALTERNATIVE

(Annual Equivalent Values)

Costs	
Construction 1/	$3,192,000
Drainage 2/	675,000
IDC 3/	281,000
Economic Cost of Energy 4/	206,000
OM&R 5/	146,000
TOTAL Costs	$4,500,000
Benefits	
Irrigation 6/	$4,949,000
Fish and Wildlife 7/	117,000
BLM 8/	70,000
Unemployment 10/	112,000
Municipal and Industrial 11/	37,000
TOTAL Benefits	$5,285,000
Net Benefits	$ 785,000
Benefit-Cost Ratio	1.17

1/ Canal and pumping plant ($41,000,000 x .08627) $3,192,000

2/ Drainage ($28,000,000 divided by 40 years x 11.17051 x .08627 $ 675,000

3/ IDC ($37,000,000 x .088 x .08627) $ 281,000

4/ Cost of Energy $\left(\frac{34{,}000 \text{ AF} \times 220' \text{ TDH}}{.75 \text{ efficiency}} \times 1.025 \times \$.0197\right)$ $ 206,000

5/ OM&R

Canal and Pumping Plant	$ 120,000
Energy (34,800 acre-feet x 314 kwh x .0025)	26,000
$\frac{34{,}800 \text{ AF} \times 220' \text{ TDH}}{.75 \text{ efficiency}} \times 1.025 \times \$.0025$	$ 146,000

6/ Irrigation

Junior Water Rights (25,000 acres x $142/acre)	$3,550,000
Fort Belknap (9,850 acres x $142/acre)	1,399,000
	$4,949,000

7/ Fish and Wildlife

OM&R (12,700 acre-feet x $3.45/acre-foot)	$ 44,000
Energy $\frac{12{,}700 \text{ AF} \times 220' \text{ TDH}}{.75 \text{ efficiency}} \times 1.025 \times \$.0197$	73,000
	$ 117,000

8/ BLM

OM&R (7,500 acre-feet x $3.45/acre-foot)	$ 26,000
Energy $\left(\frac{7{,}500 \text{ AF} \times 220' \text{ TDH}}{.75 \text{ efficiency}} \times 1.025 \times \$.0197\right)$	44,000
	$ 70,000

10/ Unemployment (37,000,000 x $3,023) $ 112,000

Table 4.10

PAYMENT CAPACITY AND REIMBURSABLE COSTS
VIRGELLE-MILK 175-ft^3/s CANAL ALTERNATIVE

	Payment Capacity ($/Acre)	OM&R ($/Acre)	Available For Repayment (/Acre) (Total/Year)	Reimbursable Costs Paid By Water User	Water Charges
Landowners with Junior Water Rights	19.63	1.23 1/	18.40	$7,770,000 2/	$19.63
Fort Belknap Reservation	19.63	1.67 3/	Deferred	$4,147,000 4/	Deferred

1/ OM&R - 7,300/34,800 x $147,000 divided by 25,000 acres = $1.23/acre
2/ Canal - 7,c00/34,800 x $37,000,000 divided by
25,000 acres divided by 40 years = $7.77/acre
Drainage - $28,000,000 x .00327 (40 years,
8-5/8 percent sinking fund) = $3.66/acre
OM&R = $1.28/acre
3/ OM&R - 3,900/34,800 x $147,000 divided by 9,850 acres = $1.67/acre
4/ Canal - 3,900/34,800 x $37,000,000

Canal Routes and Alternatives Dropped from Consideration

Five alternative canal systems were originally considered for Phase 3 - the Virgelle-Milk River, Marias-Milk River, Telegraph Creek-Beaver Creek, and the Duck Creek-Vandalia, and Tributary Dam Alternatives. These alternative canal systems are shown on Figure 4.5. The canals were originally sized at 310 ft^3/s. As can be seen from Table 4.11, the only economically feasible alternative was the Virgelle-Milk Canal Alternative. Therefore no further study was spent on the other alternatives. These alternatives are described below.

For the Virgelle-Milk Canal Alternative, four canal routes were considered - Railroad, East Side, West Side, and Creek Routes. The cost for all four routes were comparable. The Big Sandy Creek Route and Railroad Route were developed to reduce the disruption to local dryland farm operations.

The Big Sandy Creek Route was preferred by local people, but the environmental effects were not acceptable to other segments of the public, such as the Montana Department of Fish, Wildlife and Parks. The selected route - the Railroad Route - seems to be the most acceptable to all groups. The other three routes are presented here for information.

Marias-Milk Alternative

This was the primary plan proposed in the 1970 Feasibility Report by the Bureau (Bureau of Reclamation, 1970). It included an 82-mile-long canal connecting Lake Elwell on the Marias River with Fresno Reservoir on the Milk. Water would be diverted from Lake Elwell by a tunnel in the north abutment of Tiber Dam. The canal would follow the Marias River bluffs below their crest for about 10 miles before crossing cropland, and enter Fresno Reservoir.

Water could be delivered along the canal route to Lonesome and Chain-of-Lakes to benefit fish and wildlife. A fish screen would prevent the transfer from the Marias River of undesirable fish and their eggs, and parasites. Nearly 12,000 additional acres could be irrigated along this canal route, but were not included in the original cost estimate.

Table 4.11

COMPARISON OF ALTERNATIVE CANAL SYSTEMS
DROPPED FROM CONSIDERATION

	Virgelle-Milk Canal	Marias-Milk Canal	Telegraph Creek-Beaver Creek	Duck Creek-Vandalia	Tributary Dams
Average Annual Water Diverted (Acre-Feet)	92,000	108,000	144,000	63,000	70,900 1/
Average Annual Water Delivery (Acre-Feet)	77,800	77,800	77,800	56,000	23,900 2/
Acres Receiving Replacement Water 3/	149,660	149,660	149,660	107,730	46,000
Construction Cost 4/	$41,700,000	$69,200,000	$77,390,000	$55,782,000	$107,800,000
Annual Operation and Maintenance	872,000	407,000	1,125,000	114,000	365,000
Total Annual Equivalent Cost 5/	5,103,000	7,627,000	8,977,000	5,773,000	11,629,000
Annual Direct Benefits	$ 5,837,000	$ 5,837,000	$ 5,837,000	$ 4,201,000	$ 1,794,000
Benefit/Cost Ratio	1.14	.77	.65	.73	.15
Economic Cost/Acre-Foot Water Delivered 6/	66	98	115	103	487

1/ Active storage capacity of the reservoirs.
2/ Firm annual yield of the four reservoirs.
3/ Does not include canalside irrigation.
4/ The cost estimates are based on October 1984 price levels. Estimates include 10 percent unlisted items, 25 percent contingencies, and 30 percent indirect costs, except on pumping plants which have 40 percent indirects.
5/ Includes construction and interest during construction annualized at 8-5/8 percent for 100 years, annual energy cost of power, and OM&R costs.
6/ Total annual equivalent cost divided by average annual water delivery.

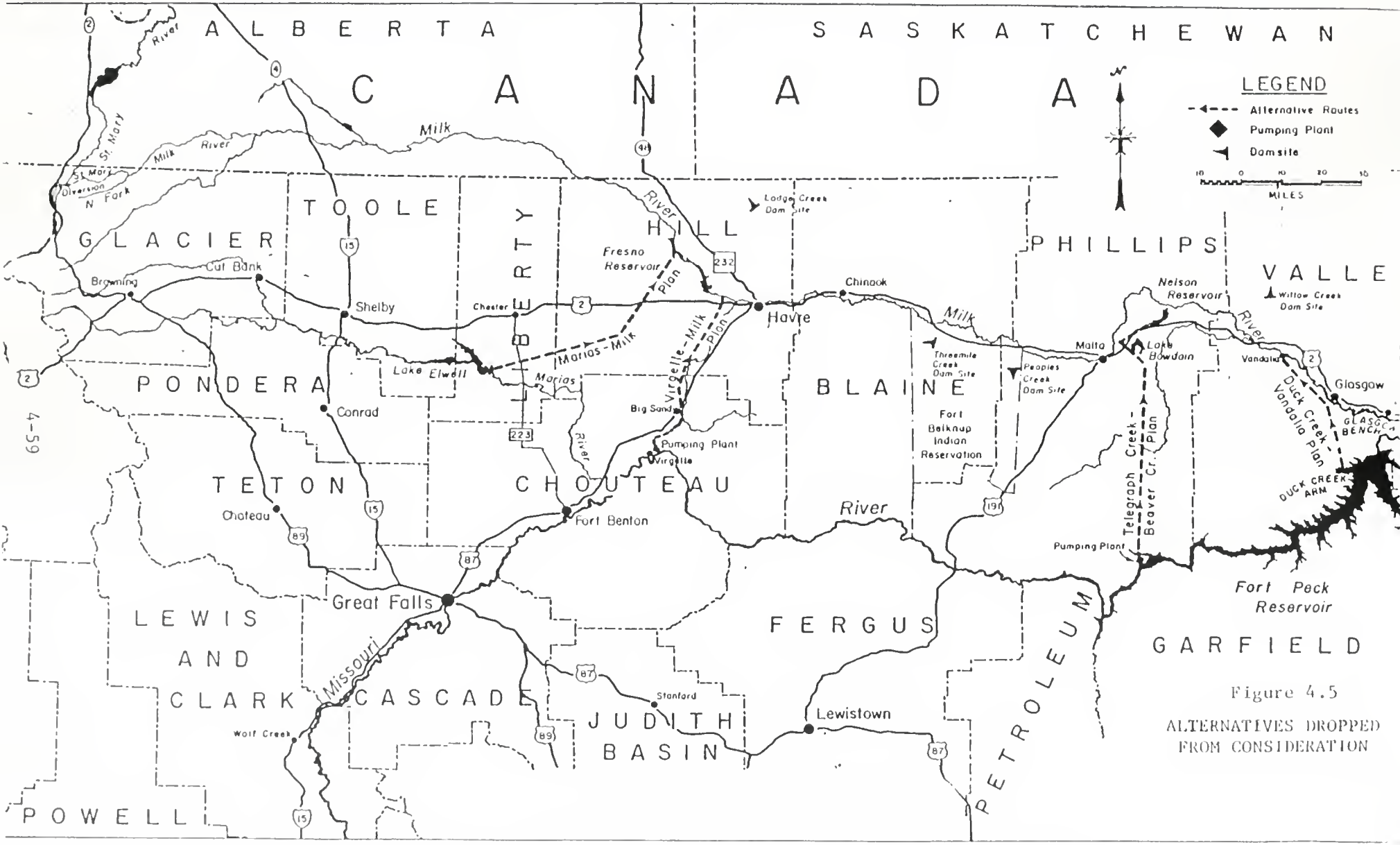


Figure 4.5

ALTERNATIVES DROPPED FROM CONSIDERATION

The canal could be routed away from the bluffs by a longer and more expensive tunnel, or it could be routed to join the Milk River below Fresno Reservoir. This latter route would eliminate the need for the fish screen, but it would increase the canal cost, making the overall cost about the same.

Telegraph Creek-Beaver Creek Alternative

This alternative would pump Missouri River water from Fort Peck Reservoir near Skibby Bottom south of Fourchette Bay near the mouth of Telegraph Creek. The water would be lifted into a 75-mile canal, which would carry the water to Nelson Reservoir, across the Telegraph Creek-Beaver Creek divide.

A 280-ft^3/s capacity pumping plant would be required, with a total dynamic head of 240 feet. Electric power for the pumping plant would come from the 161-kilovolt transmission line between Malta and Havre, requiring a substation at the line, 55 miles of new 69-kilovolt line, and a substation at the pumping plant. Peak power demand would be 7,600 kilowatts, an average annual demand of about 32,500,000 kWh.

The canal would parallel Telegraph and Beaver Creeks before entering the South Feeder Canal in Nelson Reservoir. It would be lined with compacted earth for 60 miles and unlined for the other 15 miles.

The original capacity of 280 ft^3/s would reduce to a terminal capacity of 210 ft^3/s. Major structures along the canal include 11 short siphons and 2 siphons (each 1-mile long), 1 drop structure, numerous cross drainage structures, and an inlet structure at the Nelson South Feeder Canal.

Fourteen miles of the Nelson South Feeder Canal would be enlarged from its present capacity of 500 ft^3/s to 710 ft^3/s. The canal and other major structures would be equipped with protective and escape devices as necessary.

Duck Creek-Vandalia Alternative

This alternative would divert water by gravity to the Milk River Basin from Fort Peck Reservoir. By excavating a channel from the South Fork Duck Creek

Arm of Fort Peck Reservoir to the Willow Creek drainage, water from Fort Peck Reservoir would be conveyed by 31 miles of canal through the Vandalia area to the Milk River. Enroute to the river, some water would be diverted to the Vandalia Canal for 18,000 acres of irrigated lands in the area. Water now being passed upstream might then be used to supplement irrigated lands above Vandalia.

To divert water by gravity from Fort Peck Reservoir, a cut of approximately 100 feet through the South Fork Duck Creek Arm would be required. The conveyance canal would have an initial capacity of 260 ft^3/s and a terminal capacity of 90 ft^3/s. Major structures on the canal would consist of two siphons, two drops, and laterals to the Vandalia Canal. There would also be several drainage inlets and cross drainage structures. The canal and all major structures would be equipped with appropriate protection and escape devices.

If the Fort Peck Reservoir water level were ever drawn down below the canal level, a pumping plant would be required (included in the cost estimate). The Duck Creek-Vandalia Canal inlet water surface would be at elevation 2200 feet, and the maximum drawdown of Fort Peck Reservoir would be to a water surface elevation of 2160 feet.

The peak electric power demand for the Duck Creek pumping plant would be about 1,750 kilowatts with a maximum estimated annual energy requirement of about 560,000 kWh. Power would be available from Federal facilities in the Fort Peck area.

Tributary Storage Alternative

Four offstream storage sites were considered on Lodge Creek, Three Mile Creek, Peoples Creek, and Willow Creek, all tributaries of the Milk River. Water would be stored behind these dams in the off season to be released during irrigation season.

The four dams, with a combined storage capacity of 70,900 acre-feet, would provide an additional 23,910 acre-feet of water in critical years during the irrigation season, which would benefit about 46,000 acres. In most years, more water could be provided.

Lodge Creek Dam site would be located about 25 miles north of Havre. A zoned earthfill dam 60 feet high and 1,800 feet long would be built with a grass-lined chute spillway with a concrete crest. The 2,700-acre reservoir formed by the dam could store 10,900 acre-feet of water for irrigation.

Willow Creek damsite is located in Valley County north of Hinsdale. It would be a zoned earthfill dam 82 feet high and 2,760 feet long. It would have a concrete chute spillway. The reservoir would cover 580 acres and hold 11,000 acre-feet for irrigation use.

Reclamation and DNRC reviewed 17 sites recommended by the Fort Belknap Tribal Council for dams. Two of these sites were worthy of detailed investigation - Three Mile and Peoples Creek. Three Mile Dam site would be on the reservation, 3 miles south of Fort Belknap agency. The dam would be zoned earthfill 85 feet high and 2,130 feet long. Three Mile Dam would have a concrete-lined chute spillway. The reservoir would cover nearly 1,000 acres, holding 19,000 acre-feet of water. Since the creek would not supply enough water to fill the reservoir, a 150-ft^3/s pumping plant would be necessary to add Milk River flood flows for as long as 2 months in the spring. Water would then be released when needed for irrigation.

Peoples Creek damsite is located on Fort Belknap Reservation southwest of Dodson. It would be a zoned earthfill dam 120 feet high and 1,200 feet long. It would have a concrete lined side chute service spillway and a grass lined auxiliary spillway. The reservoir would cover about 860 acres and hold nearly 30,000 acre-feet of water.

Other Virgelle-Milk Canal Routes

Figure 4.6 shows the three canal routes for the Virgelle-Milk Canal Alternative, which were considered but dropped for reasons discussed below.

The East Side Canal Route would be located on the east side of Big Sandy Creek. This route would parallel U.S. Highway 87 to the vicinity of Laredo. Here the canal would cross the highway, heading north and northeastward until it joined the Milk River west of Havre. Costs were included to line the entire 46.6 miles of this canal with compacted earth.

The East Side Canal Route needs 10 siphons, 8 concrete drop structures, 27 bridges, and a terminal drop structure, electric transmission facilities. Estimated canal cost would be $26,000,000 (excluding structures).

The East Side Canal Route would cross 56 farms, which is more than any of the other four canal routes. This route would cause the loss of 200 acres of grassland habitat. Cultural resources in the area would also be affected.

The Big Sandy Creek Route would be identical to the East Side Route to a point midway between the towns of Box Elder and Laredo, where it would jog to the west to join Big Sandy Creek. From that point to the Milk River, the creek would act as the conveyance facility. Total length would be 64.5 miles, 32 of which would be in the creek. The other 32.5 miles would require lining.

Seven siphons and six drop structures would be required for this route. No terminal drop structure would be needed, but a stilling basin near the mouth of the creek was planned. The Big Sandy Creek Route would require 20 bridges across the canal. Electrical transmission requirements would be as described for the Railroad Route.

The Big Sandy Creek Route would require work in the creek itself; earthwork along curves, 14 rock drop structures to reduce velocities to less than 2 ft/s and about 12,000 jacks 12-feet long to reduce erosion. The canal would cost $20,150,000 (structures not included), the cheapest of the four routes.

This canal route would cross 50 farms, and have the greatest effects on fisheries, water quality, aesthetics and cultural resources of the four routes.

The West Side Canal Route would be located to the west of Big Sandy Creek. North of the town of Big Sandy, this route would cross Highway 87, paralleling the creek to the vicinity of Laredo. After this point, the route would head northward to join the Milk River west of Havre.

The other three canal routes were laid out to pass through the ancient Missouri River channel with its gravel lenses and coarse soils, so they would require a full lining to reduce seepage. Only half of the 51.3 miles of the West Side Route would pass passed through these soils, and would require lining. The other half would be built in glacial till soils west of Big Sandy Creek.

The West Side Canal Route would need 6 siphons, 5 drop sructures, and 30 bridges. Electrical transmission facilities and the terminal drop structure would be as described for the Railroad Canal Route. The canal cost for this route would be $24,300,000.

This route would cross 51 farms and cause the loss of 100 acres of grassland habitat, and could affect cultural resources.

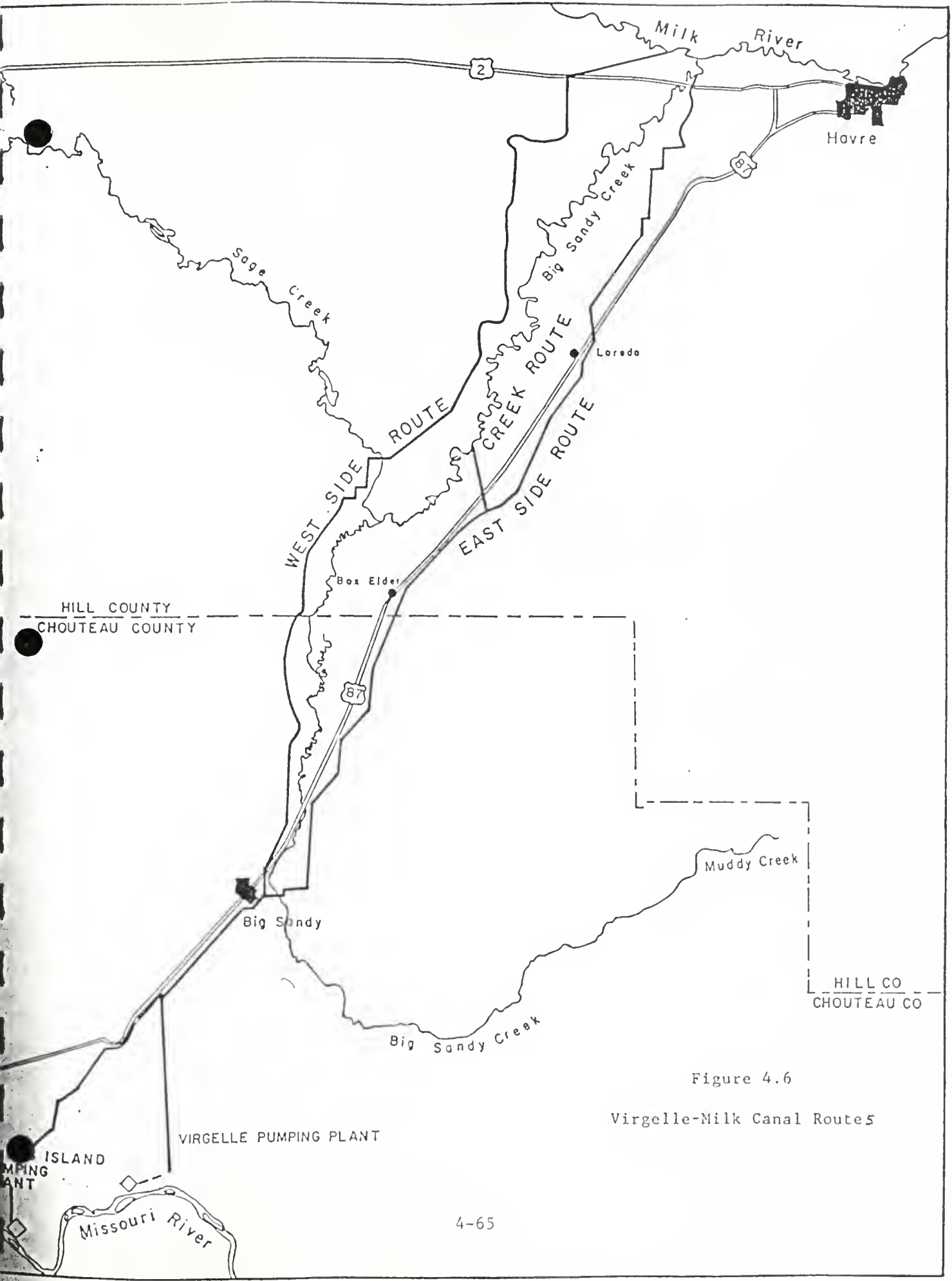


Figure 4.6

Virgelle-Milk Canal Routes

CHAPTER 5: PLAN SELECTION

The solution to the Milk River water shortage involves basin-wide management of the water supply available; rehabilitation of the aging canals, laterals, and onfarm systems; and a source of new water. The proposed three-phased plan is structured to provide this solution.

As discussed in Chapter 4, Phase 1 is ongoing, and Phase 2 would be implemented under the Rehabilitation and Betterment Program to rehabilitate the entire system. Phase 3 would provide a new water supply to the basin. The irrigators and State are seeking congressional authorization to financially integrate Phases 2 and 3 as part of the Pick-Sloan Missouri Basin Program.

A comparison of the three viable canal alternatives evaluated for Phase 3 is presented in this chapter: Virgelle-Milk 175-ft^3/s Canal Alternative, Virgelle-Milk 200-ft^3/s Canal Alternative, and Virgelle-Milk 230-ft^3/s Canal Alternative. The Virgelle-Milk 230-ft^3/s Canal Alternative was selected as the Preferred Plan.

COMPARISON ANALYSIS OF VIABLE ALTERNATIVES

Virgelle-Milk 175-ft^3/s Canal Alternative (NED Plan)

Bureau criteria require that the plan be identified which yields the maximum National Economic Development (NED) benefits for the investment. This plan is designated as the NED Plan.

The NED Plan for the Milk River Water Supply Study is the Virgelle-Milk 175-ft^3/s Canal Alternative. The landowners with junior water rights in the Milk River Basin and the Tribes on Fort Belknap Reservation would be provided a full water supply, as defined by Reclamation shortage criteria. This criteria stipulates that shortages cannot exceed 50 percent in any 1 year or 100 percent any 10 consecutive years. A water supply would also be provided to Bowdoin National Wildlife Refuge, city of Chinook, and for exchange of tributary water for BLM stockponds. The net benefits for this plan is

$1,610,000 (see NED Account on Table 5.1). There are no significant environment impacts as a result of this plan (see Environmental Account on Table 5.3. The additional water supply will improve the waterfowl habitat at Bowdoin National Wildlife Refuge. Major social effects include those resulting from the canal; the annual costs and income attributable to the plan; and the extent to which Indian lands are irrigated. Existing dryland farm operations of landowners along the canal would be disrupted (see Social Account Comparison). The plan has been formulated to limit this disruption by building the canal along the existing railroad right-of-way and providing adequate canal crossings. These farmers are also concerned about spread of weeds and increase of saline seeps. The infiltration gallery design for the pumping plant would reduce spread of weed seeds. A weed control board is recommended to ensure weed control on the canal right-of-way. Membrane lining in the canal would ensure saline seeps would not increase.

Average annual increased agricultural income (both direct and indirect) resulting from the project would be about $6.9 million. The project would include the irrigation of 9,850 dryland equivalent acres of land on the Fort Belknap Reservation, and about $2.2 million of this income would accrue to Tribal irrigators. Annual construction and OM&R costs also would be iposed on the irrigators. Annual equivalent economic costs would be about $6.4 million, with about $1.5 million of this amount accruing to the reservation. However, reservation costs would be deferred under the Leavitt Act. See Tables 5.2 and 5.3 for a complete summary of social impacts and effects under the NED Plan.

Virgelle-Milk 200-ft^3/s Canal Alternative

The Virgelle-Milk 200-ft^3/s Canal Alternative would serve the landowners with junior water rights, the Tribes on Fort Belknap Reservation, and the Chippewa-Cree Tribe on the Rocky Boy's Reservation. Water would also be provided to Bowdoin National Wildlife Refuge, BLM stockponds, and city of Chinook.

Social effects of the Virgelle-Milk 200-ft^3/s Canal Alternative would be similar to those discussed under the NED Plan, except that annual equivalent construction costs would be about 25 percent greater, and annual income would be about 10 percent higher. Thus, corollary socio-economic effects would be proportially greater. This plan includes the irrigation of 3,300 acres on the Rocky Boys Reservation. See Tables 5.2 and 5.3 for a complete summary of social impacts and effects of the plan.

NED perspective serving Rocky Boy's Reservation is not incrementally feasible (see NED Account on Table 5.1). Providing water to the reservation, however, is justified due to improved social well-being on the reservation and from a regional development standpoint (see RD Account on Table 5.1).

Virgelle-Milk 230-ft^3/s Canal Alternative (Preferred Plan)

The Preferred Plan would provide a water supply to all water users which would still experience severe water shortages after the implementation of Phase 2. This includes the water users served by the NED Plan, the Chippewa-Cree Tribe on the Rocky Boy's Reservation, and the private canalside irrigators.

Several private landowners along the canal route have indicated an interest in irrigation. It is not incrementally feasible from a NED standpoint to provide these irrigators with a water supply, distribution system, and drainage system. Therefore, they are included in the Preferred Plan, with the condition, that the costs would be funded by a non-Federal entity (see Cost Sharing). From a regional benefit standpoint, provision of irrigation services to these lands is feasible (see Table 5.1). The added direct income, as well as indirect benefits to economy of the area from irrigation services, indirect construction benefits, and benefits from OM&R expenditures, exceed the costs accruing to the region for providing irrigation (see Regional Development Accounts).

The Preferred Plan is economically justified and would have a positive effect on the environment. (See Table 5.3.)

Social effects of the Preferred Plan would be similar to those of the NED Plan, except that annual equivalent construction costs would be about 42 percent greater, and annual income would be about 19 percent higher. Thus, corollary socio-economic effects would be proportionally greater. See Tables 5.2 and 5.3 for a complete summary of social impacts and effects of the plan.

Four Account Analysis

Reclamation compares the economic, environmental and social effects of alternatives by means of the "four accounts." The four accounts are defined below and detailed in Tables 5.1 through 5.3.

National Economic Development (NED) Account: An economic analysis that displays the beneficial and adverse effects on the national economy. Benefits include increases in the economic value of the national output of goods and services and the value associated with the use of unemployed or under employed labor resources.

Regional Development (RD) Account: An economic analysis that displays the transfer of wealth between the planning region and the rest of the Nation. The region used for this analysis is the Bureau of Economic Analysis Economic Area 94, which is essentially the northern half of Montana east of the Rocky Mountains. These regional benefits include NED benefits plus income transferred to the region, including increases from irrigation services, construction impacts, and OM&R impacts. Regional benefits accruing to the Fort Belknap and Rocky Boy's Reservation are identified separately.

Fort Belknap and Rocky Boy's Regional Subaccount

The project impacts the Fort Belknap and Rocky Boy's Reservations; therefore, a regional subaccount was developed for each of the three viable alternatives (see Table 5.1). The direct irrigation benefits for the subaccounts were based on the percent Indian ownership of project lands. Employment benefits

were derived assuming 50 percent of the unskilled and 30 percent of the skilled onsite construction labor would be Indian. The incidence of indirect regional benefit segments on the reservations was determined as follows. Increases from irrigation services was apportioned based on the proportion of irrigation direct benefits accruing on the reservation, reduced by 50 percent to reflect reduced commercial or multiplier capacity on the reservation. Construction effects were based on the proportion of Indian employment, again reduced by 50 percent to reflect reduced multiplier capacity on the reservation. Operation, maintenance, and replacement effects were apportioned based on the Indian percent of OM&R labor costs.

EQ Account: This analyzes the overall affect a proposed plan would have on the environment, including significant ecological, aesthetic and cultural resource effects that cannot be measured in monetary terms.

Social Account: This account displays the impacts on the social environment, including factors like population distribution, employment opportunities, distribution of income and other social concerns.

Multi-Attribute Tradeoff System (MATS): The MATS program was used to evaluate the net effects of five impact factors which are considered to be "social resources." These factors and the weightings selected were based on an appraisal of concerns voiced by project area farmers in a series of meetings and informal questionnaires. The results of the evaluation, including gross and net social well-being (SWB) scores, are displayed in Table 5.2.

Four Tests of Viability

An alternative proposed by Reclamation must also meet "four tests" to confirm its viability. The Preferred Plan meets these four tests:

1. Completeness is the extent to which an alternative provides for all necessary investments to ensure realization of the planned effects. All costs are included to sustain irrigation on the benefiting lands for a 100-year project life and mitigation costs for environmental impacts that could not be avoided.

2. Effectiveness is the extent to which an alternative meets the specified problems and achievements. The Virgelle-Milk Canal would provide water to meet all the needs identified during the study - landowners with junior water rights, Fort Belknap and Rocky Boy's Indian Reservations, Bureau of Land Management stockwater ponds, Bowdoin National Wildlife Refuge, and water for the town of Chinook, and private canalside irrigation.

3. Efficiency examines the cost effectiveness of the various plans. The benefit to the water users of the Virgelle-Milk Canal Alternative would exceed the costs.

4. Acceptability is whether or not the plan meets acceptance by the local, state and national public. The Milk River Project irrigation districts (through their Board of Directors) and a hired consultant have been involved in plan formulation. The information presented in this report was summarized at public meetings in January 1988. The irrigation districts circulated a survey following the meeting to help determine if the Phased Plan, including the canal, is acceptable to irrigators as a whole. The results of the survey were very favorable. The State of Montana has shared in the costs of the study and also actively helped formulate the three-phased plan.

National acceptance will be measured during review of the Planning Report/Draft Environmental Statement through the legislative process.

COST SHARING

It is Department of the Interior policy at this time to require cost sharing on water resource development projects. Present guidelines for cost sharing requires that a non-Federal entity fund the difference in capital costs between the Preferred Plan and the NED Plan. In this case, the Preferred Plan ($87,000,000) costs $22,000,000 more than the NED Plan ($65,000,000). However, in this case, it is proposed that the costs for serving Rocky Boy's Reservation would be paid by the Federal Government to assure the social well-being of the reservation.

Rocky Boy's Reservation	
Additional Canal Capacity	$ 4,500,000
Distribution System	4,800,000
Drainage System	3,400,000
Subtotal	$12,700,000
Private Canalside Acres	
Additional Canal Capacity	$ 2,500,000
Distribution System	3,700,000
Drainage System	3,900,000
Subtotal	$10,100,000
Total	$22,800,000
Rounded	$23,000,000

FEDERAL REGULATIONS AND EXECUTIVE ORDERS TO BE COMPLIED WITH

To implement the Preferred or NED Plans, compliance with the following would be required: Section 10 of the River and Harbor Act of 1899 (33 USC 403), as amended; Section 404 of the Federal Water Pollution Control Act of 1972 (Public Law 92-500) as amended by the Clean Water Act of 1977 (Public Law 95-217); applicable sections of the Wild and Scenic Rivers Act of 1968 (Public Law 90-542); and Executive Order 11988, Floodplain Management.

All necessary permits would be obtained during detailed preconstruction studies.

Table 5.1
COMPARISON OF NATIONAL ECONOMIC DEVELOPMENT (NED)
AND REGIONAL DEVELOPMENT (RD) ACCOUNTS ($1,000)

	Virgelle-Milk 230-ft^3/s Canal Alternative (Preferred Plan)					Virgelle-Milk 200 ft^3/s Canal Alternative					Virgelle-Milk 175 ft^3/s Canal Alternative (NED Plan)				
		RD Account					RD Account					RD Account			
		Planning Region					Planning Region					Planning Region			
	NED Account	Total	Reservation Portion	Rest of Nation	Total	NED Account	Total	Reservation Portion	Rest of Nation	Total	NED Account	Total	Reservation Portion	Rest of Nation	Total
Annual Beneficial Effects:															
Irrigation	$ 6,084	$ 6,084	$ 1,947 1/	$ —	$ 6,084	$ 5,607	$ 5,607	$ 1,906 1/	—	$ 5,607	$ 5,122	$ 5,122	$ 1,434 1/	$ —	$ 5,122
Fish and Wildlife	140	140	—	—	140	140	140	—	—	140	140	140	—	—	140
BIM	71	71	—	—	71	71	71	—	—	71	71	71	—	—	71
Drainage	675	675	—	—	675	675	675	—	—	675	675	675	—	—	675
Unemployed Resources	156	156	156	—	156	138	138	138	—	138	112	112	112	—	112
Regional Benefits	—	4,398 2/	781 3/	-4,398	—	—	3,976 13/	730 14/	-3,976	—	—	3,570 8/	591 9/	-3,570	—
Total Annual Benefits	$ 7,126	$11,524	$ 2,844	$-4,398	$ 7,126	$ 6,631	$10,607	$ 2,774	$-3,976	$ 6,631	$ 6,120	$ 9,690	$ 2,113	$-3,570	$ 6,120
Annual Adverse Effects:															
Project Costs															
Construction	$ 4,443	$ 2,488	$ —	$ 1,955 4/	$ 4,443	$ 3,951	$ 2,004	$ —	$ 1,947 4/	$ 3,951	$ 3,192	$ 2,045	$ —	$ 1,147 10/	$ 3,192
Drainage	844	765	—	79 5/	844	675	675	—	—	675	675	675	—	—	675
IDC	391	—	—	391	391	348	—	—	348	348	281	—	—	281	281
Opportunity Costs of Power	356	356	94 6/	—	356	283	283	94 6/	—	283	215	215	3 11/	—	215
OM&R	313	313	109 7/	—	313	232	232	109 7/		232	147	147	13 12/	—	147
Total Adverse Effects	$ 6,347	$ 3,922	$ 203	$ 2,425	$ 6,347	$ 5,489	$ 3,194	$ 203	$ 2,295	$ 5,489	$ 4,510	$ 3,082	$ 16	$ 1,428	$ 4,510
Net Beneficial Effects:	$ 779	$ 7,602	$ 2,681	$-6,823	$ 779	$ 1,142	$ 7,413	$ 2,571	$-6,271	$ 1,142	$ 1,610	$ 6,608	$ 2,097	$-4,998	$ 1,610

1/ Computation based on ratio of reservation irrigated acreage to total irrigated acreage.
2/ Includes increases from irrigation services of $2,426 (000), construction effects of $1,878 (000), and labor portion (30 percent) of OM&R costs $94 (000).
3/ Includes increases from irrigation services of $385 (000), construction effects of $366 (000), and reservation portion of OM&R labor costs $30 (000).
4/ Percent of costs allocated to reservations, based on Fort Belknap and Rocky Boy's incremental capital costs of $22,600 (000).
5/ Rocky Boy's drainage costs.
6/ Based on the reservation proportion of power requirements.
7/ Reservation OM&R costs.
8/ Includes increases from irrigation services of $2,042 (000), construction effects of $1,484 (000), and labor portion (30 percent) of OM&R costs $44 (000).
9/ Includes increases from irrigation services of $289 (000), construction effects of $289 (000), and reservation portion of OM&R labor costs ($13,000).
10/ Percent of costs allocated to Fort Belknap Reservation, based on Fort Belknap incremental capital costs of $13,300 (000).
11/ Based on Fort Belknap Reservation power requirements.
12/ Fort Belknap OM&R costs.
13/ Includes increases from irrigation services of $2,236 (000), construction effects of $1,670 (000), and labor portion (30 percent) of OM&R costs $70 (000).
14/ Includes increases from irrigation services of $380 (000), construction effects of $326 (000), and reservation portion of OM&R labor costs $24 (000).

Table 5.2

COMPARISON OF SOCIAL ACCOUNTS

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal		
			230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Farms Crossed (By Canal)	The Big Sandy area is presently dryland farmed.	No change in Big Sandy area.	19 farms crossed by canal - 35 bridges provided, averaging about 1-mile intervals.	Same as Preferred Plan.	Same as Preferred Plan.
Weed Spread	Spotted knapweed and leafy spurge not known to occur along canal route.	No change in Big Sandy area.	Potential for weed spread, controlled by infiltration design pump, and weed control programs.	Essentially same as Preferred Plan.	Essentially same as Preferred Plan.
Seepage from Canal	Saline seeps occur in Big Sandy area.	No change in Big Sandy area.	Seepage from canal controlled by canal lining and toe drains.	Essentially same as Preferred Plan.	Essentially same as Preferred Plan.
Population	Rural area. Historical trend of rural population decline.	Overall population increase of about 10 percent by year 2000. Historical trend of rural population decline will continue. 1/ Increase of 100 people during 10-year construction period. Slight decrease in rate of long-term rural population loss.	Construction period population increase of 290 people, mostly in Hill and Choteau Counties. Slight decrease in rate of long-term rural population loss.	Same as Preferred Plan, except increase of 260 people during construction.	Same as Preferred Plan, except increase of 230 people during construction.
Employment	Historical trends of increases in urban and decline in rural areas. High unemployment on Rocky Boy's and Fort Belknap Reservations.	Continuation of historical trends. Unemployment on reservations will remain high. Annual direct onsite employment of 50 jobs during 10-year construction period.	Direct onsite employment during construction of 180 jobs, 70 available to Rocky Boy's and Fort Belknap Reservations. Increase of 45 agricultural jobs.	Onsite employment of 160 jobs, 60 available to reservations. Increase of 40 agricultural jobs.	Onsite employment of 140 jobs, 50 available to reservations. Increase of 40 agricultural jobs.

1/ Source: 1980 OBERS Regional Projections, U.S. Department of Commerce.

Table 5.2

COMPARISON OF SOCIAL ACCOUNTS
(Continued)

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal 230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Income (During Construction and Annual Agricultural Income)	Area is dependent upon agricultural base which is stabilized by irrigation. Per capita income below national average. Annual average water shortages of over 20 percent will continue to have an adverse impact on income.	Per capita income will remain below national average. Current dollar income will increase by 60 percent by year 2000, but ag sector by only 35 percent. 1/ Earnings during construction would be about $2.7 million. Indirect regional earnings of about $2 million. Average increased annual direct and indirect agricultural income of $8.5 million.	Direct earnings during construction would be about $6.8 million, about $2.7 million of which would accrue to Tribes. Average annual increased direct and indirect agricultural income of $8.2 million, $2.2 million of which would accrue to Tribes.	Similar to Preferred Plan, except construction earnings of $5.9 million, with about $2.3 million accruing to Tribe. Average annual increased direct and indirect agricultural income of $7.6 million; with about $2.2 million accruing to Tribes.	Similar to Preferred Plan, except construction earnings of $4.8 million, with about $1.9 million accruing to the Tribe. Average annual increased direct and indirect agricultural income of $6.9 million, with about $2.2 million accruing to Tribes.
Housing	As of 1980, housing vacancy rate of 15 percent within five counties comprising Milk River Water Supply Study service lands and canal area. Current and future rates should be comparable due to depressed rural economics.	About 20 additional housing units required during construction. Could be accommodated in project area without undue stress.	About 60 additional housing units required during construction.	Same as Preferred Plan, except 55 units required.	Same as Preferred Plan, except 50 units required.
Facilities and Services	Area typical of rural areas in the State, in which provision of social and medical services difficult due to distances traveled.	Increased pressure on medical and dental facilities during construction. Sufficient school facilities to accommodate 30 additional students.	Increased pressure on medical and dental facilities during construction. Sufficient school facilities to accommodate 100 additional students.	Similar to Preferred Plan, except 90 additional students would be accommodated.	Similar to Preferred Plan, except 80 additional students wold be accommodated.

Table 5.2

COMPARISON OF SOCIAL ACCOUNTS
(Continued)

Factor	Present	Phase 2 - Rehabilitation (Future Without or No Action)	Phase 3 - Virgelle-Milk River Canal		
			230-ft^3/s Canal (Preferred Plan)	200-ft^3/s Canal	175-ft^3/s Canal (NED Plan)
Annual Cost (Annual Equivalent Economic Cost)	N/A	Annual costs of $8.7 million.	Annual costs of $6.4 million.	Annual costs of $5.5 million.	Annual costs of $4.5 million.
Indian Lands (Acres irrigated)	N/A	N/A	13,150 acres of land irrigated on Fort Belknap and Rocky Boy's Reservations.	Same as Preferred Plan.	9,750 acres of land irrigated on Fort Belknap Reservation.

Table 5.3

ENVIRONMENTAL QUALITY ACCOUNT

Environmental Factor	Present Condition	Phase 2 (Future W/O Project) 1/	Significance 2/	Phase 3 - Virgelle-Milk River Canal Alternative					
				230-ft^3/s Canal (Preferred Plan)	Significance 2/	200-ft^3/s Canal	Significance 2/	175-ft^3/s Canal (NED Plan)	Significance 2/
Rivers									
Missouri River	Annual flow is 6,333,000 acre-feet.	Flows would continue as occur presently.	o	Project would withdraw up to 230 ft^3/s during April through September, the effects of which would be unmeasurable most years. Instream flow requirements would be met.	o	Project would withdraw up to 200 ft^3/s during April through September, the effects of which would be unmeasurable most years.	o	Project would withdraw up to 175 ft^3/s during April through September, the effects of which would be unmeasurable most years.	o
Milk River	Average annual flow in Milk River is 267,150 acre-feet.	Inflow to Milk River will decrease 40,000 acre-feet if Canadian projects are developed. Restoration of St. Mary's Canal will increase flows an average of 16,000 acre-feet.	-	Supplemental (replacement) water from Missouri River, in conjunction with future w/o conditions will assure full water supply to irrigators and maintain fish and wildlife resources.	+	Same as under Preferred Plan.	+	Same as under Preferred Plan.	+
Marias River and Lake Elwell	Lake Elwell is operated primarily for flood control. Consequently, reservoir elevations, and river flows below Tiber Dam, fluctuate considerably.	Present conditions would would continue.	o	Releases from Lake Elwell to replace instream flows in the Missouri River would increase reservoir fluctuations but should improve flows int he Lower Marias downstream of the dam in dry years.	+++	Same as under Preferred Plan.	+++	Same as under Preferred Plan.	+++
Boudoin National Wildlife Refuge	Inadequate water supply to maintain adequate water levels and freshen ponds.	Excess water could be available more often for Lake Boudoin (estimate 2,700 acre-feet annual).	+	Additional water in the Milk River could be used to benefit productivity of Boudoin National Wildlife Refuge and freshen refuge.	+++	Same as under Preferred Plan.	+++	Same as under Preferred Plan.	+++
Groundwater (Seepage)									
Milk River Basin	Existing irrigation facilities have seepage problems which, in turn, have caused the loss of agricultural productivity on the affected lands.	Rehabilitation of existing facilities and designs eliminating/reducing seepage from new facilities will return productivity to affected lands.	+	No change.	o	Same as under Preferred	o	Same as under Preferred	o

Table 5.3

ENVIRONMENTAL QUALITY ACCOUNT
(Continued)

Environmental Factor	Present Condition	Phase 2 (Future W/O Project) 1/	Significance 2/	Phase 3 - Virgelle-Milk River Canal Alternative: 130-ft³/s Canal (Preferred Plan)	Significance 2/	200-ft³/s Canal	Significance 2/	175-ft³/s Canal (NED Plan)	Significance 2/
Fisheries									
Milk River	Classified as B-3. Fisheries resources are reduced during dry years because of low runoff, low releases from reservoir, and increased withdrawals for irrigation.	Biological assessment for the individual R&B and C&R projects concluded no effect. An analysis regarding the cumulative effects concluded no effect.	o	Flows in river will be at higher level during dry years which should enhance fishery.	+	Same as under Preferred Plan.	+	Same as under Preferred Plan.	+
Missouri River	Same as Milk River.	No change.		Infiltration gallery design will minimize potential for impacting fisheries. Construction of gallery and pumping plant may disturb potential spawning areas during construction period.	o	Same as under Preferred Plan.	o	Same as under Preferred Plan.	o
Marias River	Classification is B-3 below Tiber Dam.	No change.	o	Releases from Tiber Dam would benefit fisher in Lower Marias.	+	Same as under Preferred Plan.	+	Same as under Preferred Plan.	+
Wildlife Habitat	Habitat had developed along the existing canal system and on some adjacent lands due to seepage.	Rehabilitation of existing facilities and construction of new, efficient ones will remove habitat that has developed. However, R&B and C&R projects incorporate mitigation areas to compensate for the losses.	o	Habitat losses that occur as a result of building the canal and irrigating canalside lands will be mitigated for within the canal R/W and by managing an area of Lonesome Lake. Enhancement potential exists at Lonesome Lake.	+	Habitat losses that occur as a result of building the canal will be mitigated for within the canal R/W.	o	Habitat losses that occur as a result of building the canal will be mitigated for within the canal R/W.	p
Threatened/Endangered Species	Species that could occur in the area are: peregrine falcon, bald eagle, black-footed ferret, and piping plover.	Biological assessments for the individual R&B and C&R projects have concluded no effect. An analysis regarding the cumulative effect of these actions showed no effect.	o	No effect.	o	Same as under Preferred Plan.	o	Same as under Preferred Plan.	o
Cultural Resources	There are known sites but the specifics are lacking.	Cultural resources survey and mitigation requirements have been accommodated for the individual R&B and C&R projects.	o	Class III survey of canal route and adjacent lands completed.	o	Class III survey of canal route completed.	o	Class III survey of canal route completed.	o

Table 5.3

ENVIRONMENTAL QUALITY ACCOUNT
(Continued)

Environmental Factor	Present Condition	Phase 2 (Future W/O Project) 1/	Significance 2/	Phase 3 - Virgelle-Milk River Canal Alternative					
				230-ft^3/s Canal (Preferred Plan)	Significance 2/	200-ft^3/s Canal	Significance 2/	175-ft^3/s Canal (NED Plan)	Significance 2/
Weeds	Spotted knapweed and leafy spurge presently not known to occur on lands between Milk and Missouri Rivers.	These weeds will eventually invade these lands.	—	Use of an infiltration gallery for pumping plant intake should prevent transport of seeds from Missouri River. Reclamation recommends a weed control board to assure that canal R&W is properly managed.	o	Same as under Preferred Plan.	o	Same as under Preferred Plan.	o

1/ The Future W/O Project Condition (Phase 2) assumes that the proposed R&B and C&R projects in and along the Milk River will be in place along with improvements to on-farm irrigation efficiency, prior to building the canal. The cumulative effects of this scenario regarding threatened/endangered species, and fish and wildlife resources, is presently being evaluated.

2/ - Minor adverse
— Moderate adverse
— Highly adverse
o No significant effect
+++ Highly beneficial
++ Moderate beneficial
+ Slightly beneficial

CHAPTER 6: CONSULTATION AND COORDINATION

Meetings and Issues

One of the primary tools for presenting information to the various publics was a newsletter. Issues were sent to the irrigators in the Milk River Basin; dryland operators in the Big Sandy area; Indian reservations in the area, and local, State and Federal agencies. Each newsletter dealt with status of the study and issues that had been raised by these groups.

In addition, public meetings were held at intervals during the study to report progress and obtain public input. A summary of the major meetings are listed on Table 6.1.

Reclamation and DNRC representatives frequently attended District Board meetings. Special meetings were held with smaller groups, such as the Chippewa Cree and Gros Ventre-Assiniboine Indian Tribes, and the dryland farmers in the Big Sandy area. These are also summarized in Table 6.1.

The Liberty-Hill Landowners Protection Association represented the landowners along the Marias-Milk Route (see alternatives dropped). The Big Sandy Creek Landowners Protection Association was formed to represent the landowners along the Virgelle-Milk Canal Route. The major concerns were disruption of farming operations, transport of weed seeds via the canal and poor weed control on the right-of-way, and the effect of seepage on adjacent fields.

To reduce disruption of local farming, the Creek Route (see Alternatives Dropped) was developed. By using the creek as a conveyance, less farms were severed. The Creek Route was preferred by the local people, but the environmental effects were not acceptable to the other segments of the public. A route was designed that would avoid the environmental impacts of the Creek Route and still keep disruption of farm operations to a minimum. This is the Railroad Route, the preferred route. In addition, 35 crossings have been planned along the 46-mile canal to provide farm access.

Table 6.1
PUBLIC INVOLVEMENT PLAN
SEQUENCE OF ACTIVITIES

Planning State (Time)	Public Involvement Task	Techniques
November 1983 - Before Official Start	Develop Public Involvement Task	Discuss public involvement approach and rules with DNRC and districts.
December 1983, January 1984 - Before Official Start	Review Public Involvement Plan	Review by MB Planning Division, Public Involvement Officer, and E&R Center
March 1984 - Before Official Start	Explain routing alternatives and obtain public reaction.	Held public meetings in Havre, Malta, and Glasgow. Also met with the Fort Belknap Tribal Council.
February 1984	Discuss feasibility of Rocky Boy Indian Reservation Diversion	Met with Tribal members in Great Falls. Presented costs and obligations. Attempted to get their official position. No official response.
May 1984	Inform other agencies.	Meeting held in Helena to explain study to congressional representatives and State and Federal agencies.
March 1985	Determine public preference for lower end of canal route.	There are four possible variations of the lower end of the canal route. Costs were estimated for the four variations and public preference concerning the variations sought and public meeting in Big Sandy.
Spring 1985	Meet with Milk River Irrigation District.	General meeting about proposed project.
Spring 1985	Consultation on pumping plant site.	Meet with Bureau of Land Management to discuss location of pumping plant site in Wild and Scenic section of Missouri River.
June 1985	Determine public's perception of environmental impacts.	Held a scoping session at Malta, and Big Sandy, Montana. Sent notices of session to news media, Federal Register, and all known area agencies, organizations, and individuals that might be interested.
September 19, 1985	Communicate with public in the canal route area.	Big Sandy Conservation District field day. Explained study to date. Handed out questionnaire concerning canal route.

Table 6.1
(CONTINUED)

Planning State (Time)	Public Involvement Task	Techniques
October 21, 1985	Consultation on pumping plant site and design.	Met with Bureau of Land Management to discuss alternative location of pumping plant and infiltration gallery design.
November 19, 1985	Communicate with Fort Belknap Tribal Council.	Met with Fort Belknap Tribal Council to discuss their participation in the project.
December 3, 1985	Met with Milk River Irrigation District.	Presented results of water supply model which showed some shortages caused by lack of capacity in supply canals.
January 1986 - August 1987	Determine Rocky Boy Indian Reservation participation in study.	Meetings with tribal representatives and their consultant. Meetings were held to establish lands to be classified and to present preliminary land classification results and cost estimates.
February 26, 1986	Discuss concerns of landowners along canal.	Meeting with Big Sandy Conservation District, representatives of Big Sandy Creek Landowners Protection Association, and DNRC.
May 1986	Discuss study results and receive input.	Public meetings.
December 1986	Discuss study status and conservation alternatives.	Meeting with Board of Directors.
January 1987	Discuss conservation alternatives with Chinook Division.	Meeting with Board of Directors.
March 1987	Discuss study results.	Meeting with DNRC representatives and District's consultants.
March 1987	Discuss study results.	Present study results at Irrigation Board of Directors meeting.
May 1987	Present results of study to date and receive input.	Public meetings in Glasgow, Malta and Chinook.

Table 6.1
(CONTINUED)

Planning State (Time)	Public Involvement Task	Techniques
January 1988	Present preliminary results of plan formulation.	
Various	Discuss study activities among study participants.	Meetings among State Irrigation Districts, and Bureau representatives.
Monthly	Keep public informed.	A newsletter was prepared monthly and sent to over 250 individuals and agencies on the mailing list. Each month is a different topic, i.e., weed control, pumping plant site, canal routes, planning process, use of pipe versus findings.

The second issue, weed control, was addressed at every meeting in the Big Sandy area. The Bureau proposes that a weed control board be formed that would include representatives from Choteau and Hill Counties to assure that weed control along the right-of-way is done adequately by maintenance crews. The infiltration gallery-type design which is being proposed for the pumping plant would essentially eliminate the transport of weed seeds via the canal.

Seepage, the third issue, is being addressed by lining the canal with membrane lining to keep seepage to a minimum.

The irrigation districts chose to summarize the results of the PFWD in a brochure. They sent this brochure and a questionnaire to all irrigators in the basin. This was followed by meetings with the individual groups to discuss the specific results of the study and receive their input. Meetings will continue to be held during preparation of the Planning Report/ Environmental Impact Statement.

Scoping Session Summary

Scoping sessions for the Milk River Water Supply Study were held in Big Sandy and Malta, Montana, on June 18 and 19, 1985, respectively. No oral testimony was given at either session. However, during question and answer sessions at the end of the meetings, it appeared that the largest concerns were the alignment of the canal and weed control.

Earlier on the date of the first public scoping session, a meeting was held in Great Falls for Federal and State agencies. The following concerns were raised at that meeting.

1. Will water be available for BLM uses?

2. What will be the effects of the intake structure on the Missouri Basin Wild and Scenic River?

3. What effect will project withdrawals have on boat passage?

4. Will the canal be necessary with accomplishment of rehabilitation and conservation measures?

5. Where will fencing be located?

6. What will be the effect on streamside vegetation, sediment, etc., if Big Sandy were to be used as a conveyance facility?

7. What involvement is anticipated with the Canadians?

8. Will priorities be established for use of Tiber Dam water for fisheries?

9. How will the spawning areas, and larval fish, in Missouri River be affected?

10. Will a fish screen/filter be needed on the pumping plant intake?

11. What effects will return flows from canalside irrigation have on Big Sandy Creek?

12. How will weeds be controlled?

All records regarding the above meetings are maintained by the Missouri Basin Region, Bureau of Reclamation, Billings, Montana.

Coordination With U.S. Fish and Wildlife Service

According to the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service must provide an assessment of the effects of any action Proposed by Reclamation. The U.S. Fish and Wildlife Service (USFWS) Provided a preliminary assessment of the effects of the proposed project on fish and wildlife resources. Fish and Wildlife Service draft recommendations are as follows. A Coordination Act Report will be prepared by the U.S. Fish and Wildlife Service for the Planning Report/ES.

Recommendation 1. Mitigate reduction of flows in the Missouri River by altering the releases from Tiber Dam. In turn, depending upon how the releases from Tiber Dam are altered, the Marias River fishery could either be enhanced, degraded, or remain unchanged.

Response. Prior to completion of the Planning Report/Environmental Statement a plan to determine the best operation for both the Missouri River and the Marias River will be developed by the USFWS; Montana Department of Fish, Wildlife and Parks; Bureau of Land Management and the Bureau of Reclamation.

Recommendation 2. Prevent the transfer of carp from the Missouri River to the Milk River.

Response. The infiltration-gallery design for the pumping plant in the Missouri River would prevent transfer of carp.

Recommendation 3. The area of the Missouri River where the intake system would be located is known to have the highest densities of larval fish in the Middle River. In addition, paddlefish and shovelnose sturgeon may spawn in this area. Adverse impacts should be prevented.

Response. The infiltration-gallery design for the pumping plant would prevent impingement or entrainment of larval fish and fish eggs.

Recommendation 4. Construct powerline to minimize raptor electrocution.

Response. Powerlines will be constructed in accordance with Suggested Practices for Raptor Protection on Powerlines: The State of the Art in 1981.

Recommendation 5. To mitigate for loss of native rangeland with the canal right-of-way, the right-of-way must be fenced and seeded with native grasses and forb species.

Response. Adopted

Recommendation 6. To mitigate for loss of 1,315 acres of native rangeland in areas to be irrigated along the canal, lands in the Lonesome Lake area will be managed for wildlife.

Response. Adopted

The USFWS is presently working on enhancement proposals for Lonesome Lake and Big Sandy Creek. Those proposals will be evaluated when received, and would be subject to non-Federal cost sharing if adopted.

REFERENCES

Bureau of Reclamation, 1977; Milk River Feasibility Study.

_____Reclamation Instruction 511.1.40

_____Reclamation Instruction 516.

Bureau of Reclamation, U.S. Soil and Conservation Service, Montana Department of Natural Resources and Conservation, March 1987. Milk River Project Water Measurement Data.

Bureau of Reclamation, August 1987; Draft Report on Proposed Rehabilitation and Betterment Program, Malta Division, Milk River Project.

Bureau of Reclamation, August 1987; Draft Report on Proposed Rehabilitation and Betterment Program, Glasgow Division, Milk River Project.

Department of Commerce, 1970; 1970 OBERS BEA Regional Projection.

Montana Department of Natural Resources and Conservation, 1977. Supplemental Water for the Milk River.

Montana Water Resources Board, 1967. Water Resources Survey, Blaine County, Montana.

_____, 1967. Water Resources Survey, Hill County, Montana.

_____, 1967. Water Resources Survey, Phillips County, Montana.

_____, 1967. Water Resources Survey, Valley County, Montana.

ATTACHMENT 1

The Milk River Simulation Model

Major data input to the model included historic streamflows, crop irrigation requirements, irrigation efficiencies, canal capacities, irrigated acreages, as well as reservoir capacities, area capacity tables, and seepage and evaporation tables.

Streamflows

Streamflow inputs define the available water supply for the Milk River Project. The Milk River has a streamflow regime governed primarily by snowmelt. Mean annual flow of the river at the eastern crossing of the border was 369 ft^3/s or 267,150 acre-feet/year. Of this, an average of 140,000 acre-feet/year was contributed from the St. Mary River Basin. Mean annual flow increases to 693 ft^3/s (501,700 acre-feet/year) near the river's mouth at Nashua. The model uses gauging records of streamflows for the mainstem of the Milk River at the international eastern crossing and 15 major tributaries. These gauges measure runoff from approximately 50 percent of the entire Milk River Drainage Basin. Missing records of the gauges and flows of ungauged contributing basins were estimated using standard hydrologic methods. Figure A-1 is a schematic diagram showing the relative location of tributaries in the Milk River Basin below the eastern crossing.

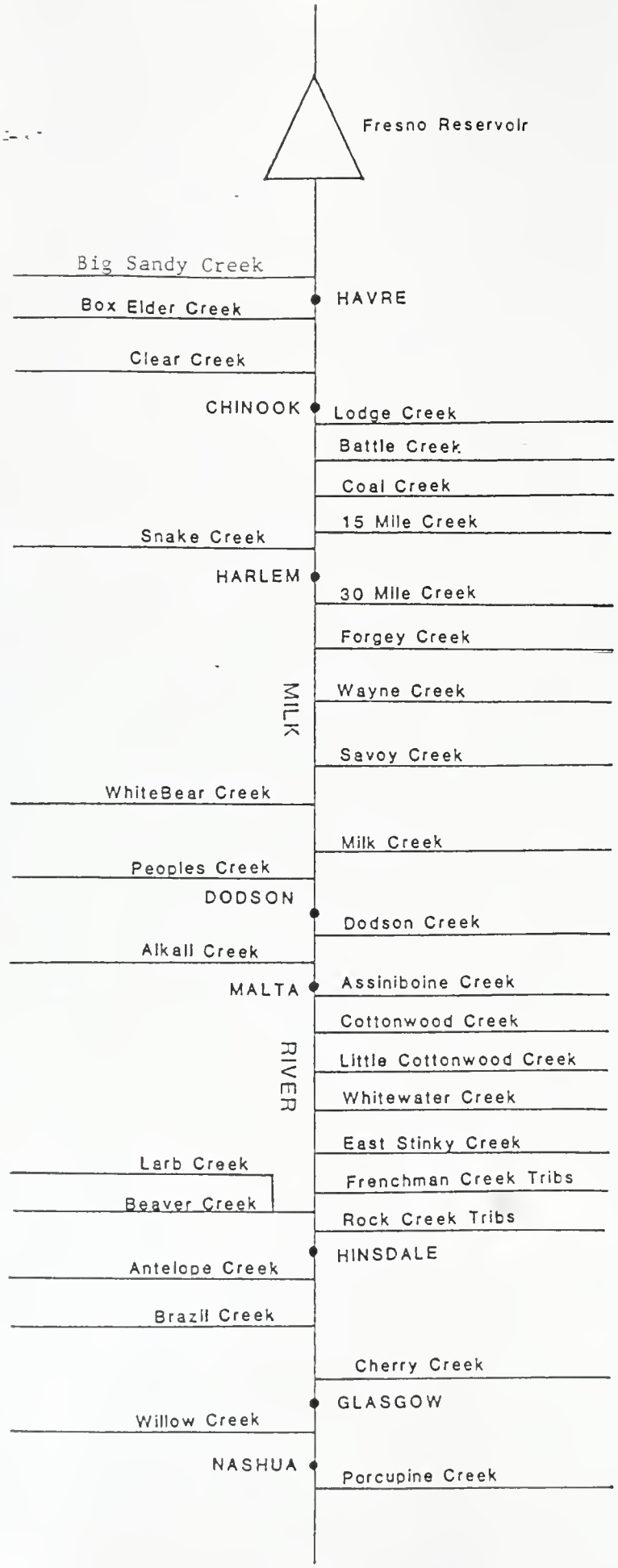


Figure A-1

Tributaries to the Milk River

Crop Irrigation Requirements

Crop irrigation requirements, in combination with irrigation efficiencies and irrigated acreages, were used to determine the total demand for irrigation water. On the more productive soils in the Milk River Project, alfalfa and small grains are the predominant crops with some land in irrigated pasture. Heavier soils are limited to production of western wheatgrass (known locally as "bluejoint" grass), a cool season crop characterized by low yields and relatively low water requirement. Table A-1 shows the percentage of each irrigated crop within the three divisions of the Milk River Project.

Table A-1. Crop Distribution of the Milk River Project (percent)

Crop	Chinook Division	Malta Division	Glasgow Division
Alfalfa	48	31	38
Grain	14	7	38
Pasture	9	22	4
Bluejoint Grass	29	40	20

Monthly crop irrigation requirements for alfalfa, small grains, and irrigated pasture were calculated for each division for each year, using the CIR77 program (USDOI, 1976) based on the Jensen-Haise evapotranspiration formula. The CIR77 program also accounts for soil characteristics, effective precipitation and irrigation practices in estimating the amount of irrigation water necessary to fully mature the crops. Lacking an appropriate crop coefficient for use in the Jensen-Haise formula, mean monthly irrigation requirements for native bluejoint grass were estimated and held constant from year to year. Bluejoint fields in the project are flooded early in the season when surplus water is usually available. During the rest of the season, other crops are generally given higher priority for irrigation water, so bluejoint fields are irrigated when water is available. Annual irrigation requirement for bluejoint was estimated to be 5 inches, of which 3 inches were distributed over the months of April, May, and June. Table A-2 gives the mean crop irrigation requirements for each division weighted for all crops.

Table A-2. Average Crop Irrigation Requirements in Inches (Weighted by Crop)

Month	Chinook Division	Malta Division	Glasgow Division
April	0.30	0.40	0.30
May	1.63	1.77	0.87
June	3.80	2.27	3.01
July	3.49	3.17	3.85
August	2.78	2.73	2.10
September	0.80	0.95	1.25
October	0.15	0.26	0.15
Total	12.95	11.55	11.53

Irrigation Efficiencies

Overall irrigation efficiency (the percentage of diverted water beneficially used by the crop) may be broken down into conveyance efficiency (the percentage of diverted water conveyed to the farm headgate) and onfarm efficiency (the percentage of water reaching the farm headgate delivered to the crop root zone). Two conveyance systems are used in the project: unlined earth canals are used to distribute water in the irrigation districts, with an average conveyance efficiency estimated to be 64 percent (SCS, 1978), and some individual irrigators who pump water directly from the river through pipelines to the farm site, at an estimated efficiency of 90 percent.

Onfarm efficiency depends on the method of irrigation. Approximately 80percent of the Milk River Project is irrigated by gravity systems and 20 percent with sprinkler systems. Border dikes are the most common method of gravity irrigation.

Onfarm efficiencies of border dike systems in the project have averaged approximately 25 percent (USBR, 1987). Onfarm efficiencies for sprinkler systems are estimated to be 70 percent. Table A-3 summarizes conveyance and onfarm efficiency inputs to the Milk River model.

Table A-3. Estimated Irrigation Efficiencies (Percent)

	Onfarm	Conveyance	Overall
Bluejoint Grass			
River pumper gravity systems	25	90	23
Irrigation District gravity systems	25	64	16
All Other Crops			
River pumper sprinkler systems	70	90	63
Irrigation District gravity systems	27	64	17
Irrigation District sprinkler systems	70	64	45
Average (Weighted by Crop and Area)			22

Irrigated Acreages

Irrigated acreage was another data input needed to calculate the total demand for irrigation water. Irrigated acreage was based on the 1967-1968 water resources survey completed by the DNRC for Blaine, Valley, and Phillips Counties. Survey figures were updated by field observations during the 1985-1987 land classification (see "Lands to be Served," in Chapter 3). Acres irrigated by pumpers were identified in the field and subdivided into "contract" or "private" pumpers. (Contract and private pumpers could receive water directly from the river or from an irrigation district canal.) Table A-4 presents the irrigated acres used as input to the model.

Table A-4

IRRIGATED ACRES
MILK RIVER

	Acres
Fort Belknap Canal	
Fort Belknap District	6,050
Alfalfa Valley District	3,500
Zurich District	6,350
Junior Water Right Lands	270
Contract Pumpers	250
	16,420
Paradise Valley Canal	
Paradise Valley District	8,140
Junior Water Right Lands	430
	8,570
Harlem Canal	
Harlem District	10,680
Junior Water Right Lands	80
	10,760
Fort Belknap Indian Reservation	10,420
Dodson North Canal	
Dodson District	1,010
Malta District	9,350
Contract Pumpers	470
Junior Water Right Lands	720
	11,550
Dodson South Canal	
Malta District	15,700
Contract Pumpers	1,220
Junior Water Right Lands	1,480
	18,400
Nelson Canal	
Malta District	17,100
Contract Pumpers	360
Junior Water Right Lands	570
	18,030
Vandalia Canal	
Glasgow District	15,000
Junior Water Right Lands	850
	15,850

Table A-4
IRRIGATED ACRES
MILK RIVER
(Continued)

	Acres	
Junior Water Right Lands		
From Fresno to Havre	650	
From Havre to Chinook	450	
From Chinook to Harlem	390	
From Harlem to Malta	3,100	
From Malta to Saco	2,850	
From Saco to Hinsdale	240	
From Hinsdale to Vandalia DD	10,710	
From Vandalia DD to Nashua	1,800	
	20,200	
Contract Pumpers		
From Havre to Fort Belknap DD	1,350	
From Fort Belknap DD to Paradise Valley DD	860	
From Paradise Valley DD to Harlem	480	
From Harlem to Dodson Diversion Dam	1,110	
From Dodson Diversion Dam to Malta	180	
From Malta to below Nelson North Canal	2,030	
From Nelson North Canal to Vandalia DFD	2,020	
	8,030	
Subtotal along Canals		110,000
Districts	92,900	
Fort Belknap Indian Reservation	10,400	
Contract Pump	(2,300)	
Junior Water Right Lands	(4,400)	
Subtotal along River		28,230
Contract Pumpers	(8,030)	
Junior Water Right Acres	(20,200)	
Total Irrigated		138,230
Subtotal Junior Water Right		24,600
Along Canals	4,400	
Along River	20,200	
Subtotal Contract Pumpers		10,330
Along Canals	2,300	
Along River	8,030	
Total Pumpers		34,930

General Calculations

Crop irrigation requirements and irrigation efficiencies were used to calculate monthly diversion requirements to satisfy the area served by each canal. When total monthly demand on the canal exceeded the canal capacity, demand was reduced to capacity. In this case, a facility shortage was calculated as the increment of demand beyond the canal capacity. Facility shortages are significant in evaluating Milk River irrigation shortages as they cannot be remedied by an increase in water supply alone.

Monthly return flows for each district were estimated by subtracting crop consumptive use and an estimate of irrecoverable 1/ loss from the total irrigation diversion. The volume available as return flows was then lagged over a 3-month period, with 70 percent of the volume returning in the month of the irrigation, 20 percent the next month, and 10 percent in months thereafter.

While a longer duration for return flows is more typical, the 3-month distribution period was used for two reasons. First, typical operations of the Milk River districts cause large operational wastes, and thus a large proportion of return flow occurs through surface channels as opposed to groundwater flow. Also, calibration runs of the model which compared simulated and historic streamflows, were made with various return flow distributions. From these runs, a 3-month distribution of return flow seemed more appropriate for the Milk River Basin.

To establish demand on the reservoirs, the spatial distribution of demands with respect to tributary flows and return flows was analyzed. The Fort Belknap Reservation was given priority use of all tributary inflows upstream of the reservation. When upstream tributary inflows exceeded the

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1/ Irrecoverable losses are water losses from the distribution system which cannot be returned to the river within 1 year. Examples are evaporation from canals, nonbeneficial evapotranspiration, deep percolation, and wind drift.

reservation's demands, the increment above the reservation demand was considered available for use by the non-Indian districts. Total demand on the reservoirs was equal to the sum of the demands in excess of the tributary inflows and return flows available for use at each demand point. Nelson Reservoir is sometimes dependent on Fresno Reservoir for its inflows, so a trial operation of Nelson was done each month to establish its demand on Fresno.

Once Fresno demands were set, final reservoir computations were done. Inflows to Fresno (natural flows and water diverted from the St. Mary River Basin) were apportioned between the Fort Belknap Reservation and the non-Indian districts. Releases from Fresno were used to satisfy irrigation and municipal demands, and then end-of-month (EOM) storage volumes were calculated. Distinctions between Indian and non-Indian releases and storage volumes were maintained in all computations and releases were made within the constraints of operating criteria. When demands on Fresno Reservoir were low, a minimum release of 25 ft^3/s was maintained. Releases in the summer months may be reduced to maintain a minimum storage of 10,000 acre-feet for municipal demands through the fall and winter. In the winter months, Fresno Reservoir storage levels were forecast, and if necessary, drawdown releases were made to reduce storage to 70,000 acre-feet by March 1. Reservoir evaporation for each month was calculated from estimates of the mean reservoir surface area for the month and mean monthly evaporation derived from local evaporation pan data.

With Fresno operations completed, releases were routed through the system by the model. Diversions and return flows at each demand point were simulated in a downstream sequence, with shortages computed and return flows recalculated based upon the simulated diversion. Accounting of Indian and non-Indian water was maintained through the system. Flows were routed through Nelson Reservoir, where calculation of releases, evaporation, seepage, and EOM content were made. Mainstem streamflows of the Milk River were estimated at 17 nodes, 6 of which have historic gauging records for comparison.

Comparison of Model Results With Historic Flows

To determine the accuracy and applicability of the model, a baseline run simulating historic conditions was made. The stream gauge at Havre, the first gauge on the Milk River mainstem below Fresno Reservoir, was used to demonstrate how accurately Fresno releases were simulated. Correlation analysis using the Havre gauge revealed simulated and historic values correlated significantly (a 5 percent significance level for a T-test was used in all analyses) for both annual flows and May through September irrigation season flows. Annual correlation had an "R" of .95. Figure A-2 shows a plot of the annual hydrographs of mean monthly values for both simulated and historic flows at the Havre gauge.

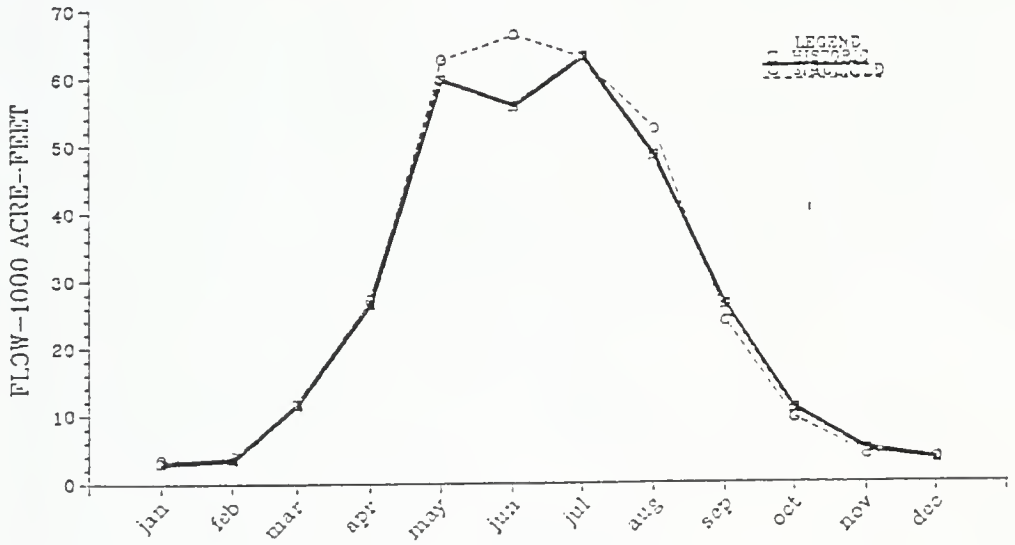

Figure A-2. Historic and simulated hydrographs of mean monthly flows of the Milk River at Havre for the period 1955-1985.

The last gauge on the Milk River mainstem at Nashua is 21 river miles upstream of the mouth. Model results at this site indicated how well the total operation of the Milk River Irrigation Project was simulated. Correlation analysis using the Nashua gauge showed that simulated and historic values correlated significantly for both annual flows and May through September irrigation season flows. Annual correlation had an "R" of .96.

Figure A-3 shows a plot of the mean annual hydrographs of simulated and historic flows at the Nashua gauge.

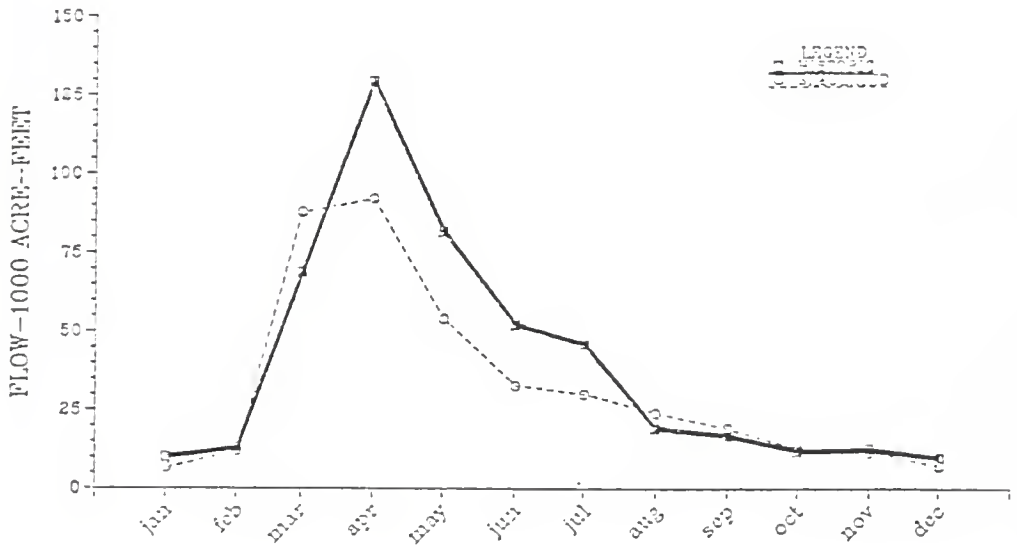

Figure A-3. Historic and simulated hydrographs of mean monthly flows of the Milk River at Nashua for the period 1955-1985.

Comparison of model results with historic flows at the Havre and Nashua gauges revealed that the model accounted for the variability of historic flows but did not accurately duplicate the historic flow. Inspection of the data showed that the simulated flows consistently deviated from historic flows at both gauges during high flow years, perhaps because a significant part of tributary inflow in the basin is ungauged and would have to be estimated. Estimating techniques, unfortunately, would not accurately represent high flow

conditions. And, while certain characteristics of the irrigation systems vary from year to year depending upon moisture and other conditions, they were represented in the model by constants. Constant values of factors like the bluejoint grass irrigation requirement and irrigation efficiencies were probably more representative of low rather than abnormally high water conditions. Table A-5 shows a comparison of simulated flows with historic flows for the 10 driest years during 1955-1985. A paired T-test revealed the simulated flows for these years were not significantly different from historic for either irrigation season or annual flows at the two gauges. The conclusion, is therefore, that the Milk River model is best suited for simulating average and below average water supply conditions, appropriate to our primary objective of evaluating irrigation shortages in the basin.

Table A-5. Comparison of Simulated Flows with Historic Flows at Two Locations for 10 Low-Flow Years in the Period 1955-1985

Gauging Site	Historic Mean Annual Flow (1,000 ac-ft)	Simulated Mean Annual Flow (1,000 ac-ft)	Historic Mean Irrigation Season Flow (1,000 ac-ft)	Simulated Mean Irrigation Season Flow (1,000 ac-ft)
Havre	238.1	236.1	204.5	197.5
Nashua	162.0	163.1	59.4	60.8

Results of the model are listed in Chapter 3, "Resources."

ATTACHMENT 2

ECONOMIC CRITERIA

FARM BUDGET ANALYSIS

The farm budget method of analysis was used to determine both the benefits and repayment ability of the project lands. Composite budgets were prepared to reflect the varying farming practices and land uses along the Milk River. These budgets incorported data from Blaine, Phillips, and Valley Counties.

Repayment budgets were done for the year 1995 to represent those irrigated lands, receiving a full water supply and those lands receiving a supplemental water supply. These budgets were considered to depict the baseline conditions and the anticipated repayment ability in the first year of project service. This set of budgets were extended to illustrate typical benefits levels over the life of the project.

Farm Size

The composite farm size represents the modal size for the three counties located within the proposed project area. Derivation of the modal farm size is shown in Table A-6. The 7,753-acre size was further verified from additional sources and local interviews.

In accordance with P&G requirements, the farm size was projected for repayment purposes to represent the 1995 level and benefit farms at the economic mid-point of the benefits (8 years at 8.625 percent). The projection was made through the use of a linear analysis of USDA census data. This procedure yields a repayment size of 8,764 acres and a benefit size of 9,400 acres.

Land Use

The major reason for the large units is the vast amount of low yielding rangeland (approximately 7 acres per cow-calf unit per month) required to maintain the cow herd. Range accounts for about 74 percent of the land in the three county area. The rangeland in the composite budget also accounts for 74 percent of the land area in the unit. Cropland, fallow, and miscellaneous unproductive land accounts for the remaining farm acreage.

Specific information comparing county data and farm budgets is presented in Table A-7. The crop distribution used in the farm budget is as follows.

	Crop Distribution (Percent)	
	Without Project	With Project
Irrigated Alfalfa Hay	---	1.59
Irrigated Barley		.39
Irrigated Pasture		.48
Irrigated Other Hay		1.00
Irrigated Alfalfa Seed		.06
Irrigated Spring Wheat		.19
Irrigated Waste		.13
Dryland Barley	2.00	1.48
Dryland Fallow	9.08	8.53
Dryland Wheat	9.29	6.88
Dryland Other Hay	.51	.38
Dryland Alf@lfa Hay	.40	.30
Owned Range	31.11	31.11
Leased Range	43.33	43.33
Dryland Unproductive	4.28	4.15
	100.00	100.00
Straw	9.08	9.10

Irrigated Acres

According to the 1982 Census of Agriculture, there are 115,998 acres irrigated in the three county study area. The majority of these acres, over 61 percent, are in farms greater than 2,000 acres in size. The average number of acres irrigated in these large farms is 298 (Table A-8). Although the acreage

listed above is shown as irrigated in the farm budgets, the actual number of acres irrigated in the farm budgets is slightly less to allow for irrigation waste for ditches, O&M roads, etc.

Dryland Acres

The dryland crop rotations in the farm budgets were developed using Blaine, Phillips, and Valley County dryland crop statistics. The basic dryland crop rotation has remained much the same for the past 20 years. However, the recent trend has ben toward slightly more small grain crops at the expense of the hay crops. Therefore, the last 5 years of published data (1981-1985) was used for the dryland crop rotations (Table A-7). It was assumed that the

Table A-6

Land in Farms Plus Harvested Cropland
for Farms with Irrigation
Blaine, Phillips, Valley Counties, 1982

Farms by Land in Farms (acres)	Farms (No.)	Farms (%)	Total Acres (No.)	Total Acres (%)	Harvested Cropland (No.)	Harvested Cropland (%)
1- 9	4	.7	D	---	D	--
10- 49	30	5.3	213	---	140	.1
50- 69	7	1.2	242	---	122	--
70- 99	20	3.5	1,629	.1	696	.3
100- 139	18	3.2	1,844	.1	1,121	.4
140- 179	22	3.9	3,428	.2	1,848	.7
180- 219	20	3.5	3,842	.2	1,621	.6
220- 259	19	3.3	4,544	.2	1,862	.7
260- 499	69	12.2	24,794	1.3	11,792	4.1
500- 999	55	9.7	39,754	2.0	17,757	6.2
1000-1999	65	11.5	93,016	4.6	26,687	9.2
2000+	238	42.0	1,845,145	91.3	224,802	77.7
TOTAL	567	100.0	2,020,438	100.0	289,615	100.0
Mean			3,563		511	
Mode		2,000 + acres	7,753		945	

Source: 1982 Unpublished U.S. Bureau of Census Data Tapes, Montana, Land in Farms and Harvested Cropland for Farms with Irrigation.

D = Not published to avoid disclosure.

Table A-7

Comparison of Gross Land Use in
Farms with Irrigation in Blaine, Phillips,
and Valley Counties (1982 and the Farm Budgets)

Item	Composite			
	County Statistics		Farm Budget	
	Acres	%	Acres	%
Land in Farms	2,020,438	100	7,753	100
Harvested Cropland	288,985	14	989	13
Fallow	177,876	9	667	9
Rangeland	1,498,974	74	5,771	74
Unproductive-Farmstead	54,603	3	322	4
Irrigation-Waste	---	--	10	--

Source: 1982 U.S. Census of Agriculture, Volume 1, Geographic Area Series, Part 26, Montana State and County Data, Table 2 Irrigation, Pages 132, 134, and 135 - Published by U.S. Department of Commerce, Bureau of the Census.

Table A-8

Irrigated Acres by Farm Size
Blaine, Phillips, Valley Counties

Acres	Number of Farms	Total Irrigated Acres	%	Average No. of Irrigated Acres by Farm Size
1- 9	4	D	D	D
10- 49	30	158	.1	5
50- 69	7	156	.1	22
70- 99	20	879	.8	44
100- 139	18	1,310	1.1	73
140- 179	22	1,905	1.6	87
180- 219	20	1,742	1.5	87
220- 259	19	2,229	1.9	117
260- 499	69	10,945	9.4	159
500- 999	55	12,148	10.5	221
1000-1999	65	13,116	11.3	202
2000+	238	70,862	61.1	298
TOTAL	567	115,998	99.4	205

Source: 1982 Census of Agriculture, Volume 1, Geographic Area Series, Part 26, Montana State and County Data, Table 4 - Land in Farms, Harvested Cropland, and Irrigated Land, Page 160

Table A-9

Composite Summary of Major
Dryland Crop Acreage

Year	Acres			
	Barley	Wheat	Alfalfa	Other Hay
1966	161,600	362,500	24,500	85,700
1967	121,400	449,200	25,800	59,500
1968	127,600	398,700	25,000	63,600
1969	143,800	344,800	30,000	72,100
1970	146,900	332,100	33,000	69,500
1971	115,000	455,900	32,300	53,700
1972	163,900	426,400	30,700	105,900
1973	184,800	461,000	25,700	73,600
1974	116,700	517,500	32,800	62,700
1975	120,400	546,500	26,700	47,200
1976	100,500	603,700	36,200	53,500
1977	114,600	567,100	38,700	53,500
1978	93,500	563,500	39,500	94,400
1979	67,800	596,300	33,500	75,300
1980	58,800	593,700	24,000	39,900
1981	70,100	659,200	32,000	38,200
1982	109,200	677,000	31,400	49,900
1983	133,600	528,400	26,000	37,900
1984	177,300	527,500	18,600	10,700
1985	117,000	431,900	13,300	18,100
20-Year Average				
Acres	122,225	502,145	28,985	55,110
%	17.2	70.9	4.1	7.8
10-Year Average				
Acres	104,240	574,830	29,320	47,140
%	13.8	76.1	3.9	6.2
5-Year Average				
Acres	121,440	564,800	24,260	30,960
%	16.4	76.1	3.3	4.2

Source: Montana State Agricultural Statistics 1966-1985.

irrigated crop rotations would not change under dryland conditions; therefore, the dryland percentages on the "without" irrigation budget were increased to include the irrigated crops. The irrigated pasture was converted to other hay.

Irrigated and Dryland Yields

It was estimated that the first year of water delivery in the Milk River Water Supply Study would be 1995.

Projected yields were obtained by developing a yield trend line using a linear regression analysis of the previous 20 years of record data. The maximum yields were obtained through a literature search pertaining to the project area. The trend line was projected until the maximum yields would be achieved. The benefit analysis yields used were developed by determining when the highest yields would be achieved and spreading this throughout the life of the project. These yields do not exceed those currently being attained by better farmers in the area and are considered representative of future conditions. The irrigated yields are summarized in Table A-10, and hayland crop yields are shown on Table A-11. The rangeland yield of .15 AUM's per acre was based on information supplied by the Bureau of Land Management. The projected crop yields used in the analysis are shown below.

	Benefit	Repayment
Irrigated		
Alfalfa Hay (tons)	5.0	3.6
Barley (bushel)	73.8	67.0
Pasture (AUM's)	8.7	8.4
Other Hay (tons) 1/	3.9	2.0
Alfalfa Seed (cwt's)	3.2	3.1
Spring Wheat (bushel)	90.6	77.1
Dryland		
Wheat (bushel)	31.9	
Barley (bushel)	33.6	
Other Hay (tons)	1.0	
Alfalfa Hay (tons)	1.5	
Range (AUM's)	1.5	

1/ Includes bluejoint, alfalfa brome, mixed grasses, grain hay.

Table A-10

Irrigated Crop Yields

Year	Barley (Bu.)	Spring Wheat 1/ (Bu.)	Alfalfa Hay 2/ (Ton)	Pasture 2/ (AUM)	Other Hay 2/ (Ton)	Alfalfa Seed 2/ (CWT)
1966	48.2	32.8	2.8	3.4	1.1	---
1967	47.2	26.2	2.8	3.1	1.0	---
1968	35.8	35.8	3.0	3.1	1.1	---
1969	46.7	32.4	3.1	3.0	1.1	10
1970	48.9	32.1	3.0	3.0	1.2	---
1971	41.4	30.1	2.8	4.2	1.2	---
1972	53.7	35.8	2.9	5.7	1.3	---
1973	45.0	38.1	3.0	5.3	1.4	---
1974	45.7	41.8	2.8	5.3	1.5	---
1975	47.0	36.4	3.0	7.3	1.4	1.0
1976	46.5	40.4	3.1	7.0	1.3	---
1977	49.1	47.6	2.9	7.0	1.3	1.1
1978	57.8	40.8	2.8	6.5	1.5	---
1979	59.2	38.4	2.9	6.6	1.3	4.63
1980	46.4	45.0	2.9	5.3	1.6	3.22
1981	58.1	49.4	3.3	3.9	1.6	1.80
1982	58.8	53.8	3.5	5.1	1.7	1.06
1983	53.2	53.2	3.4	4.6	1.6	1.78
1984	51.6	49.8	2.3	5.0	1.1	3.68
1985	35.7	50.6	2.3	4.9	1.2	1.68
Mean (s)	48.80	40.53	2.93	4.97	1.33	2.55 4/
Standard Dev. (2s)	6.76	8.14	.30	1.43	.20	---
Standard Dev. X = Outside 2s	13.52	16.27	.60	2.85	.40	---
Unadj. R2	.34	.91	-.04	.46	.58	---
Adj. R2 (1995)	NA	NA	NA	NA	NA	---
Unadj. Yield (1995)	56.34	64.81	2.89	7.13	1.72	---
Adj. Yield	NA	NA	2.94 3/	NA	NA	---
Yield Used	56.3	64.8	3.0	7.1	1.7	2.6

1/ Composite Montana Agricultural Statistics for Blaine, Phillips, Valley Counties.
2/ USBR Statistics for Milk River Projects.
3/ 10-Year average (1976-1985).
4/ Based on the last 7 years of data.

Table A-11

Dryland Crop Yields

Year	Barley 1/ (Bu.)	Wheat 1/ (Bu.)	Alfalfa Hay 1/ (Ton)	Other Hay 1/ (Ton)
1966	34.6	23.4	1.3	1.0
1967	20.1	16.0	1.3	.8
1968	37.6	20.6	1.2	1.0
1969	36.8	24.8	1.3	1.1
1970	35.1	23.4	1.5	1.0
1971	28.5	20.0	1.0	.9
1972	37.1	25.0	1.4	1.2
1973	31.7	23.5	1.0	1.0
1974	30.7	22.6	1.7	1.1
1975	31.5	35.0	1.7	1.0
1976	41.7	28.2	1.3	1.2
1977	33.4	24.2	1.5	1.1
1978	42.8	29.3	2.0	1.4
1979	27.8	19.4	1.4	1.0
1980	26.0	23.4	1.4	.8
1981	30.8	22.3	1.6	1.0
1982	42.9	32.0	1.8	1.2
1983	31.9	27.3	1.1	.7
1984	20.8	18.6	.7	.7
1985	12.9 x	10.2 x	.5 x	.5 x
Mean	31.24	22.96	1.34	.99
Standard Dev. (s)	7.63	4.81	.36	.21
2 Standard Dev. (2s)	15.26	9.63	.72	
X = Outside 2s				
Unadj. R2	-.19	-.00	-.14	-.31
Adj. R2	.04	.33	.08	-.13
Unadj. Yield (1995)	33.50	23.02	1.16	.77
Adj. Yield (1995)	33.06	27.95	1.46	.93
Yield Used	33.1	28.0	1.5	1.0 2/

1/ Composite Montana Agricultural Statistics for Blaine, Phillips, and Valley Counties.

2/ Based on 20-year mean (1966-1985).

Prices Received

The prices received are based on the most recent 20-year local prices received. The corresponding Gross National Product deflator for each price year is used to compute a 20-year average constant price. This price is then reindexed to the current year for use in the farm budget analysis. This methodology brings the prices paid and received to a common point.

Barley	$ 2.66/bu.
Wheat	4.15/bu.
Alfalfa Seed	107.00/cwt
All Hay	72.82/ton
Alfalfa Hay	73.89/ton
Other Hay	65.46/ton
Cows	47.53/cwt
Heifers - Replacement	72.95/cwt
Heifers - Feeder Calves	75.96/cwt
Steers - Feeder Calves	79.88/cwt
Bulls	62.20/cwt

Prices Paid

The following prices paid were used in the analysis.

	Unit	Level	Dollars/Unit
Seed Costs			
Barley	bu.	actual	5.40
Wheat	bu.	actual	6.60
Alfalfa - Certified	cwt.	actual	235.00
Pasture	cwt.	actual	87.00
Fertilizer Costs			
Ammonium Nitrate, 33.5 percent N	ton	actual	200.81
Super Phosphate, 45 percent P205	ton	actual	262.76
Other Costs			
Fargo	gal.	actual	36.08
2, 4-D	gal.	actual	9.50
Malathion, 5 lbs./gal.	5 gal.	actual	86.30
2, 4-DB Amine	5 gal.	actual	69.50
Twine	bale	actual	19.85
Skilled Labor	hr.	actual	4.85
Hired Labor	hr.	actual	3.70
Insurance - Buildings	$1,000	actual	4.35
Insurance & Licenses - Cars & Trucks	total	actual	640.00

Prices Paid, (continued)

Other Costs, (continued)

Insurance - Farm Liability	total	actual	92.00
Telephone - Farm Share	total	actual	500.00
Electricity - Farm Share	total	actual	925.50
Regular Gas, Bulk	gal.	actual	1.17
Diesel Fuel	gal.	actual	.96
Oil	qt.	actual	1.07
Filters - Car & Trucks	total	actual	3.85
Filters - Tractors, Swathers, Combine	total	actual	12.00

Livestock Expenses

Marketing Costs			
Hauling (50-60 miles)	cwt.	actual	.43
Buying & Selling Commission	cwt.	actual	.43
Miscellaneous Costs			
Salt & Minerals	cwt.	actual	33.00
Vet Medicine	cow	actual	7.00
Barley Cake	cwt.	actual	6.86
Barley Pellets	cwt.	actual	7.37
Barley Rollings	cwt.	actual	.45

NED IRRIGATION BENEFITS

Net farm incomes were taken from the farm budgets representing the condition with and without the project. The net increase with the project is $51,692/farm (see Table A-12).

A negative value was obtained because of the internal working of the farm budget program which does not reflect any equity on the unit. The rationale for this is the opportunity cost of money should be considered.

Net farm incomes was taken from the budget. From the increase net income, allowances for management and labor were deducted. The management allowance was derived using 10 percent factor of the increased net farm income. The additional labor required was used to determine the labor allowance. A summary of irrigation benefits is shown in Table A-12. The annual irrigation benefit is $142-per acre.

Table A-12

Annual National Economic Development (NED) Irrigation Benefits

	Full Service
Net Farm Income With Project	$-19,085
Net Farm Income Without Project	-73,228
Increase Net Income/Farm	$ 54,143
Less:	
6 Percent of Variable Production Costs	1,029
Labor Allowance	1,692
NED Irrigation Benefits Per Farm	$ 51,692
Acres Irrigated	361
NED Benefits Per Irrigated Acre	$ 142

The "without the project" budget represents dryland farming. The privately irrigated lands along the canal route and the land to be served on Rocky Boy's Reservation are presently dryland farm operations. The benefit for each acre irrigated is $142. The same benefit value per acre was used for the land irrigated by landowners with junior water right and the lands on Fort Belknap Reservation. However, the number of acres for which benefits were claimed was based on the dryland equivalent acreage. That is, of the 24,425 acres assumed to be irrigated on the Fort Belknap Reservation, 9,850 acres would have to be taken out of production in order for the remaining lands to receive a full water supply. (Full water supply is defined by Reclamation guidelines as shortages cannot exceed 50 percent in any 1 year or 100 in any 10 consecutive years.) Benefits of $142/acre were claimed for 9,850 acres.

In the case of the lands irrigated under junior water rights, $142/acre benefits were claimed for the entire 25,000 acres. After adjudication, these lands would have no water supply at all during extremely dry years, and diversions would be reduced over 10 percent in 6 out of 10 years. There is not adequate water supply to provide a full water supply to these lands, landowners should revert to dryland operation.

PAYMENT CAPACITY

The payment capacity per acre is estimated to be $19.63 (see Table A-13). Based on the repayment farm budget, the net farm income with the project, projected to year 1995, is $27,355. The standard family living allowance (per Department of the Interior criteria) is $20,800. This leaves a payment capacity of $6,556 per farm. Assuming there are 334 irrigated acres per farm, the payment capacity per acre is $19.63

Table A-13

Payment Capacity

Net Farm Income, With Project		$31,443
Net Farm Income, Without Project		4,088
Net Farm Income, With Project		$27,355
Less:		
Family Living Allowance 1/		
Management Return 2/	(2,736)	
Labor Allowance 3/	(2,097)	
Equity Allowance 4/	(695)	
Balance of Living Allowance	(15,271)	
		$20,794
Available Payment Capacity		$ 6,556
Acres Served		334
Payment Capacity Per Acre		$ 19.63

1/ Standard family living allowance is $20,800 per Department of the Interior criteria.

2/ Ten percent of increase net farm income.

3/ Increased labor for irrigation.

4/ 3.4 percent of equity increase.

Attachment 3

This attachment presents a summary of the Rehabilitation and Betterment, Construction and Rehabilitation, and Onfarm Efficiency Improvement Elements. These elements are presented in detail in the Rehabilitation and Betterment Reports for the Glasgow, Malta, Chinook (includes Dodson Pump) Divisions.

Rehabilitation and Betterment Element

Glasgow Division

1. Place a slip-form concrete lining or pipe in 22 miles of laterals

2. Line the Vandalia Canal with compacted earth

3. Replace the concrete lining of 500 feet of the Vandalia Canal

4. Realign, deepen, and rehabilitate ____miles of open drains and construct additional drains

5. Install Parshall Flume measuring devices at diversion points of project laterals and at delivery points of laterals scheduled for rehabilitation.

Malta Division

1. Install a new lift system for a movable crest on the Dodson Diversion Dam

2. Realign, reshape, and complete earthwork on reaches of the initial 5 miles of the Dodson South Canal

3. Replace eight check structures on the Dodson South Canal with new radial gate check structures

4. Relocate the terminal reach of the Bowdoin Canal

5. Enlarge the first 3-mile reach of the Dodson North Canal

6. Replace two flumes on the Dodson North Canal with siphons

7. Install a PVC membrane lining on a 7-mile reach of the Dodson South Canal

8. Replace the gate lifts on the headworks of the Nelson South, Nelson North, Dodson South, and Bowdoin Canals and on the Points-of-Rocks Reservoir

9. Install slip-form concrete linings on 27 miles of laterals

10. Install pipe in 8 miles of laterals

11. Repair concrete on cross drainage culvert transitions, lateral turnout structures, siphon transitions, and check structures

12. Rehabilitate 30 miles of open drains

13. Construct 7 miles of new drains

14. Install Parshall Flume devices at diversion points of laterals and onfarm delivery points of laterals being rehabilitated.

Chinook Division

1. Place slip-form concrete lining or pipe in 18 miles of laterals

2. Reshape earth lateral and place compacted earth lining in 61 miles of canals and laterals

3. Place PVC membrane lining in 10 miles of the Fort Belknap Canal, 5 five miles of the Paradise V@lley Canal and 6 miles of the Harlem Canal

4. Repair the necessary structures

5. Realign, deepen, and rehabilitate open drains and build additional drains.

Construction and Rehabilitation Element
Glasgow Malta and Chinook Division

1. Replace the Dodson Diversion Dam and modify the Fort Belknap Diversion Dam

2. Install buried membrane linings in 4 miles of the Dodson South Canal, 16 miles of the Dodson North Canal, 2.25 miles of the Bowdoin Canal, 3 miles of the Nelson South Canal, 5.5 miles of Lateral NS 25, 14 miles of the Fort Belknap Canal, 5 miles of the Paradise Valley Canal, 6 miles of Harlem Canal, 16 miles of the Vandalia Canal and 20 miles of laterals

3. Install concrete linings in .6 mile of the Vandalia Canal and in 80 miles of laterals

4. Construct 14 miles of pipe laterals

5. Reshape 45 miles of earth laterals

6. Replace 1,000 turnout structures

7. Install 1,300 new measuring devices

8. Construct 10 new check structures

9. Install automated slide gates on the headworks of the Fort Belknap and Paradise Valley Canals

10. Construct 100 miles of O&M roads and gravel surfacing 150 miles of roads

11. Rehabilitate and extend 114 miles of drains

12. Install devices for remote monitoring, supervisory control and automation

13. Construct six new shop and storage buildings and three new headquarters buildings

14. Mitigate impacts to wildlife habitat.

Onfarm Efficiency Improvement Element
Glasgow, Malta, and Chinook Division

The goals of onfarm improvement are to conserve water by reducing the irrigation demand, increase crop production through more efficient use of water, decrease labor required for farm operations, and distribute water more equitably throughout the Milk River Basin.

Onfarm conservation requires two parts: the implementation of a basin-wide irrigation management system, and a program of onfarm improvements and operational changes designed to increase the irrigation efficiency by 15 percent over the present level.

The management system will be controlled by a single water master responsible for distributing water throughout the basin in an equitable and efficient manner. Scheduling and distribution of water will be based on up-to-date flow information from the measuring devices included in the rehabilitated delivery system. Irrigation records for each delivery will be recorded and incentives included in a revised rate structure, with graduated rates and surcharges to motivate irrigators to be more efficient. Consulting and educational services will also be provided to design onfarm improvements and to assist in basin-wide irrigation scheduling.

Onfarm improvements are designed to raise irrigation efficiency from its average estimated 27 percent, to about 42 percent. Improvements include field leveling, border dikes, gated pipes, concrete-lined head ditches, sprinklers, re-use pits and automated controls on head ditches. Operational changes will also be made to make the improvements effective, including shorter irrigation set times and more efficient scheduling of irrigation applications.

The onfarm program depends on an efficient and the well-maintained distribution system brought about by the Rehabilitation and Betterment and Construction and Rehabilitation elements. The three elements could be implemented at the same time.

Cost estimates for each type of physical improvement were based on a sample application and then reduced to a cost per acre. These costs were then multiplied by the number of acres assumed to be included for each type of improvement in order to arrive at a total estimated project cost. These costs include installation of measuring devices at all delivery turnouts. Costs also include 10 percent unlisted, 15 percent contingency and 15 percent indirect, except for sprinklers and gated pipe. The costs for concrete-lined ditches was estimated using information obtained from the Soil Conservation Service and Greenfield Irrigation District; 15 percent indirect costs were added to this.

Table A-14 displays an array of measurements and plans with associated costs and water savings. An onfarm plan that would achieve a 15 percentage point efficiency increase would cost about $20,000,000.

Table A-14
Onfarm Improvement, Costs and Water Savings

	(1)	(2)	(3)			(4)			(5)			(6)		
Plan Number			#1			# 2			# 3			# 4		
Conservation Method	% EFF. Change	Cost/ Acre	% Part.	% Water 1/ Savings	Cost 2/	% Part.	Water Savings	Cost	% Part.	Water Savings	Cost	% Part.	Water Savings	Cost
Sprinklers	47	$550	8	3.8	4.1	10	4.7	5.1			—			—
Land Leveling	6	270	11	.7	2.8	24	1.4	6.0	40	2.4	10.0	28	1.7	7.0
Border Dikes	6	10	11	.7	.1	29	1.7	.3	40	2.4	.4	40	2.4	.4
Concrete Head Dikes	3	300	5	.2	1.4	12	.4	3.3	—	—	—			
Automated Gates (Requires Concrete Ditches)	15	100	5	.8	.5	10	1.5	.9	—	—	—			
Gated Pipe	6	180	5	.3	.8	12	.7	2.0	65	3.9	10.9	65	3.9	10.9
Operational Changes														
a) Shorter Irrigation Sets	12	—	10	1.2	—	25	3.0	—	35	4.2	—	35	4.2	—
b) Change in Number and Timing of Irrigation	8	—	10	.8	—	20	1.6	—	35	2.8	—	35	2.8	—
SUBTOTAL				8%	9.7		15%	17.6		16%	21.3		15%	18.3
TOTAL Including Measuring Device at Delivery Turnouts					11.7			19.6			23.3			20.3

1/ Water savings is calculated by multiplying the percent efficiency change by the percent participation.
2/ Cost is calculated by multiplying the percent participation by 93,000 acre (total number of acres irrigated by district and contract pumpers that are not sprinkler irrigated) and then multiplying by the cost per acre.

Col. (1): Percent Efficiency Change: This is the onfarm efficiency increase expected if the conservation measure is implemented. The present condition was assumed to be 27 percent efficient.
Col. (2): Cost/Acre: Estimated cost per acre for implementing each conservation measure.
Col. (3): #1 Plan: This plan represents a participation level assuming cost sharing farm improvements and minor rate structure changes for water which would result in an 8 percent water savings.
Col. (4): #2 Plan: This plan is a modification of #1 plan assuming higher landowner participation through stronger rate structure incentives. Water savings would be 15 percent.
Col. (5): #3 Plan: This plan was formulated assuming sprinkler and concrete head gates and automation would not be included and assuming a higher participation in operational changes.
Col. (6): #4 Plan: Same as #3 plan except land leveling has been adjusted so the total efficiency increase is 15 percent for comparison to other plans.